

1. *BOTHRIONEURON VEJDovskyANUM* Stole.

B. vejdoskyanum, Stole, S.B. Böhm. Ges. 1885, p. 647; id. Abh. Böhm. Ges. (2) vii. p. 43; Beddard, Monogr. Olig. 1895, p. 269.

Bothrioneurum vejdoskyanum, Michaelsen, "Oligochæten" in Tierreich, 1890, p. 54.

Body covered with papillæ. Male pores single and median in xi. Clitellum xi., xii. An integumental vascular network present. Genital seta present on xi. Spermatophores numerous, attached to body-wall in neighbourhood of male pore.

2. *BOTHRIONEURON AMERICANUM* Beddard.

B. americanum, Beddard, Ann. Nat. Hist. (6) xiii. p. 206; Hamb. Magalh. Sammelreise, Naiden &c., 1896, p. 6; Monogr. Olig. 1895, p. 269.

Bothrioneurum americanum, Michaelsen, "Oligochæten," Tierreich, 1900, p. 54.

Male pores paired on xi. Clitellum xi., xii. An integumental vascular network present. No genital setæ. Spermatophores absent(?).

3. *BOTHRIONEURON IRIS*, n. sp.

Male pore single and median on xii. Clitellum xii., xiii. No integumental vascular system. No genital setæ. Spermatophores only present to the number of one.

February 19, 1901.

Dr. HENRY WOODWARD, F.R.S., Vice-President, in the Chair.

Mr. F. E. Beddard, F.R.S., exhibited the skin of a female Monkey (*Cercopithecus schmidti*) from a specimen lately living in the Society's Gardens (received September 25th, 1900; died February 17th, 1901), which showed a pair of additional mammae below and slightly to the inside of the normal pair. One of the supplementary mammae, that of the right side, was fully as large as the normal mammae.

Dr. W. G. Ridewood exhibited under the microscope mounted slides of the hairs of two Zebras, *Equus burchelli* and *E. zebra*, for comparison with the hairs of the recently described *E. johnstoni* Selater (see P. Z. S. 1901, p. 50), and called attention to the fact that no differences in structure could be observed between the hairs of these three species.

With reference to the same subject the following extracts from a letter addressed by Prof. J. C. Ewart to Mr. Beddard, who had

forwarded to Prof. Ewart a piece of the skin of *E. johnstoni*, were read:—

“I have compared the hair from the piece of skin you kindly sent with the hair of antelopes, oxen, deer, and other Ruminants, and with the hair of zebras and other Equidæ.

“The conclusion arrived at is that the pieces of skin sent home by Sir Harry Johnston belong to a Zebra.

“In all the Equidæ the hair has the same general structure, but yet it is possible to distinguish zebra-hair from that of the horse and the ass. In wild asses even the light hairs are longitudinally striped, in zebras only the coloured hairs are striped, while in horses neither the light nor the dark hairs show any stripings. In being striped the hairs from the Congo skin differ from the hairs of antelopes, and agree with those of the asses and zebras. As in the Congo skin the white hairs show no longitudinal striping, it may be assumed it belongs to a zebra rather than to one of the asses. To which of the known zebras does the Congo one most closely resemble?

“Judging by the hairs on the piece of skin sent it decidedly differs from the Quagga (*Equus quagga*), the Mountain Zebra (*E. zebra*), and the Burchell's Zebras (*E. burchelli*) of East and South Africa.”

The following papers were read:—

1. Notice of an apparently new Estuarine Dolphin from
Borneo. By R. LYDEKKER.

[Received January 17, 1901.]

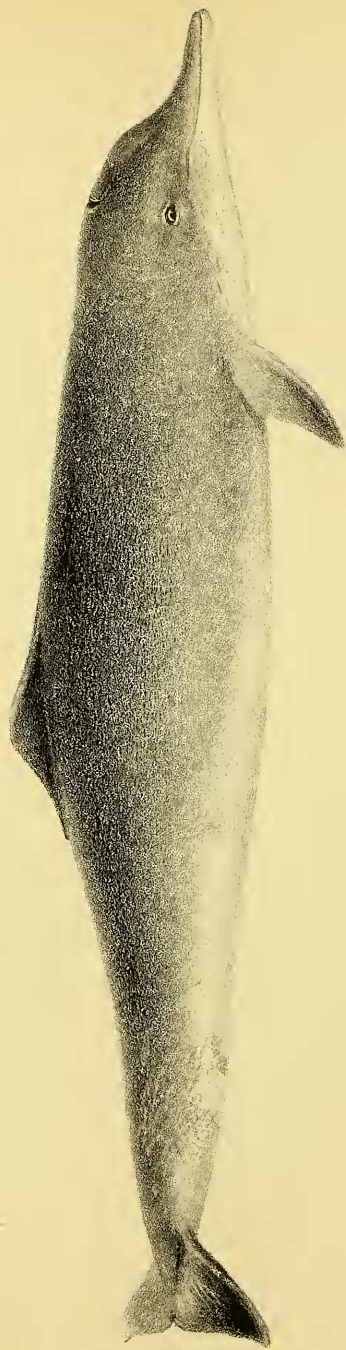
(Plate VIII.)

(Text-figure 11.)

The skin and skeleton of a female Dolphin from Borneo, recently purchased by the British Museum from Mr. E. Hose, do not accord with the description of any species with which I am acquainted, and therefore seem to indicate a new form. The specimen was obtained at Sipang, on the mouth of the Sarawak River.

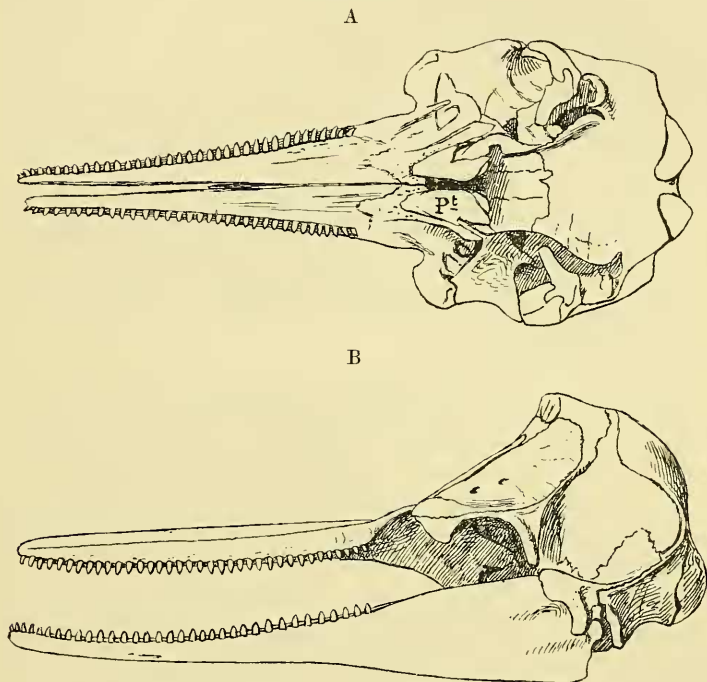
The total length of the skin is approximately $5\frac{1}{2}$ feet. The beak is comparatively long and narrow, and at the base the forehead rises very abruptly, showing a distinct prominence or boss some distance in advance of the blow-hole. The flippers are falcate, but the dorsal fin is obtuse, low, and continued both in front and behind as a low ridge extending for a length of about fourteen inches along the back.

The general colour of the upper-parts is blackish; but the under-parts are much mottled with a light tint, which is yellow in the dried state, but during life was probably buffish white or whitish. Nearly the whole of the chin is of this light tint, and there are patches of it at the roots of the flippers; in the hinder half of the body and tail it extends some way up the sides.



The skull (text-fig. 11) at once shows that the specimen belongs to the *Sotalia-Steno* group of Dolphins, to which comparison may accordingly be restricted. The pterygoids are widely separated from one another in the middle line; and the teeth, which are of medium size, smooth, and antero-posteriorly compressed, number 36 in the upper, and 34 in the lower jaw. Unfortunately the skeleton is somewhat incomplete posteriorly, so that the total number of vertebræ cannot be ascertained. There are, however, 30 in the precaudal series.

Text-fig. 11.

Lower view (A) and lateral view (B) of the skull of *Sotalia borneensis*.*Pt.* Pterygoid.

As regards the distinction between *Steno* and *Sotalia*, Messrs. Flower¹ and True² included all the forms with divided pterygoids in the latter, and those with conjoint pterygoids in the former. Mr. Blanford³, however, has transferred the three Indian species *S. plumbeus*, *S. perniger*, and *S. lentiginosus* from *Sotalia* to *Steno*,

¹ List of Cetacea in Brit. Mus. pp. 31 & 32 (1885).

² Bull. U. S. Nat. Mus. No. 36, pp. 153 & 156 (1889).

³ Fauna of Brit. India: Mammalia, pp. 582-585.

although they have divided pterygoids, stating that he thinks it desirable to await the examination of the complete skeleton before placing them in the typical South-American genus *Sotalia*. All three differ from the present form by their much larger teeth; while *S. plumbeus* and *S. perniger* (*gadamu*) are further distinguished by their tall and falcate dorsal fins, and *S. lentiginosus* by its speckled skin. The other Indian form, *S. frontatus*, is a true *Steno*, with conjoint pterygoids and rugose teeth. There are also many other differences, such as variation in the number of teeth.

As already mentioned, the specimen agrees with *Sotalia* and differs from *Steno* (exclusive of the Indian forms referred to that genus by Mr. Blanford) in the separation of the pterygoids. It further agrees with the former in the relatively large number of teeth and the smoothness of their enamel; Mr. True giving the number of teeth in *Sotalia* as from 26 to 35, and in *Steno* from 20 to 27. In *Sotalia* the number of vertebræ varies from 51 to 55, of which 29 are precandal; but in *Steno* the number is increased to 66, of which 35 are precaudal. In its 30 precaudals the present specimen agrees sufficiently well with *Sotalia*.

It may therefore be taken that the specimen is not only referable to the last-named genus, but likewise to the typical Brazilian section of the same. The Indian forms (referred by Mr. Blanford to *Steno*) have been already differentiated, while the white *Sotalia sinensis*, in addition to its larger teeth, is readily distinguishable by its coloration.

The South-American species, especially those from the Upper Amazons, are probably sufficiently distinguished by their geographical distribution, but a few words may be added in regard to them. Both *Sotalia pallida* and *S. fluviatilis*, of the Upper Amazons, are broadly distinguished by the smaller number of their teeth, there being $\frac{30}{31}$ in the former and $\frac{28}{23}$ in the latter. *S. pallida* further differs by the whitish colour of the upper-parts, while the peculiar distribution of the colours forms another point of difference in *S. fluviatilis*.

Comparison is more difficult in the case of the three forms respectively known as *S. tucuxi*, *S. guianensis*, and *S. brasiliensis*. The former of these is typified by two skulls in the British Museum from the Upper Amazons, the number of teeth in which is $\frac{30}{30}$. This form, if not identical with *S. pallida*, is probably very closely allied.

Sotalia brasiliensis, from Rio de Janeiro, was described on the evidence of an immature specimen, and is said to be blackish above, with the sides fulvous, the belly white, and the flippers coloured like the back; the number of the teeth being $\frac{34}{33}$. In many respects this form appears to come very close to the one under consideration. Sir William Flower was, however, of opinion that *S. brasiliensis* might prove to be the young of *S. fluviatilis*. And apart from this, the figures given by Van Beneden (reproduced in pl. iii. of Mr. True's memoir) seem to indicate that the dorsal fin of



brasiliensis is more pointed than that of the Bornean Dolphin, and lacks the anterior ridge-like extension of the latter. Moreover, the head is less elevated above the beak than is the case in the present form, although it is true that this may be due to immaturity. In the skull of the Brazilian species the beak appears to be much wider than in the specimen under consideration, while the teeth seem relatively larger. *S. guianensis*, which is said to have $\frac{32}{29}$ teeth, may be identical with one of the foregoing; and, in any case, is too imperfectly known to admit of exact comparison, in the absence of the type specimens.

I have not been able to identify the Brazilian specimen with any of the South-American Dolphins recently described by Dr. R. A. Philippi¹, and am indeed doubtful whether any of them belong to *Sotalia*.

Under these circumstances I see no other course but to make the Bornean Dolphin, at least provisionally, the type of a species, for which the name *S. borneensis* will be appropriate. The specific characters will be apparent from the description above given.

The specimen was captured on September 12th, 1900.

2. Note on the Kashmir Ibex (*Capra sibirica sasin*).

By R. LYDEKKER.

[Received January 22, 1901.]

(Plate IX.)

(Text-figure 12.)

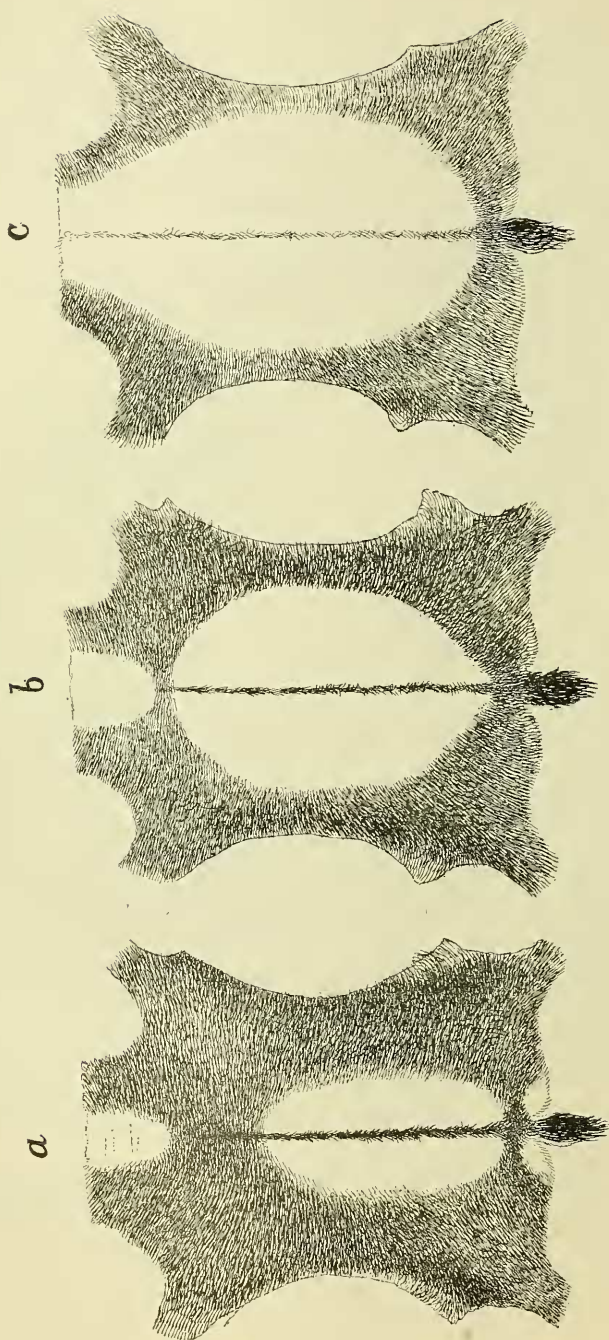
So far as I am aware, no coloured figure of the Ibex inhabiting the mountains which border the northern and eastern sides of the Valley of Kashmir has ever been published, and I accordingly desire to direct attention to a skin which, through the intervention of Rowland Ward, Ltd., will shortly be acquired by the British Museum. The animal (a male) to which this skin belonged was shot by Captain E. F. Holden below the Zogi-la, the pass on the Leh route dividing the Sind Valley of Kashmir from the Tibetan district of Dras. Captain Holden has had the head mounted for his own collection, and the remainder of the skin he has kindly offered to present to the Museum.

This animal was in the winter coat at the time of its death; and is, I take it, the *Capra sakeen* of Blyth, which is generally described as of a dirty white colour in winter, with dark underparts and legs, and browner in summer. Few naturalists, I think, have, however, any idea that it is really as white as is shown to be the case by the present example, which may be briefly described as follows:—

Whole of back and the basal portion of the neck creamy buffish white, with a very faint and incomplete light brown dorsal streak, becoming broader and darker towards the tail, which is

¹ An. Mus. Chile, 1893 and 1896 (No. 12).

Text-fig. 12.



Body-skirts of (a) Irfish, (b) Baltistan, and (c) Kashmiri races of the Asiatic Ibex.

black, with chestnut tips to the hairs. A narrow band of very pale greyish fawn along each flank; thighs and shoulders a darker fawn; legs deep golden brown, with a small patch of brownish buff on the back of the hinder pair, above the lateral hoofs. The head, as in all the allied forms, is brownish.

Here it may be mentioned that I regard the Kashmir Ibex not as a distinct species, but as a local race of the Asiatic Ibex, under the name of *C. sibirica sacin* (see text-fig. 12, c, p. 92).

Recently I have described¹ a second race of the species, from Baltistan, as *C. sibirica wardi*. Of this race the Museum possesses the mounted type example presented by Mr. Rowland Ward, and an imperfect skin given by Mr. St. George Littledale; both specimens being in the winter dress. Contrasted with the foregoing race, this form presents the following distinctive features:—

Buffish-white area on back considerably smaller, with a more distinct and darker dorsal streak, and thus forming only a "saddle." Another patch of buff on nape of neck also buffish white. Whole of remainder of upper-parts, under-parts (except abdomen, which is whitish), limbs, and tail dark brown, varying somewhat in shade in different parts; in some cases (as in Mr. Littledale's example) a patch of brownish buff on the posterior surface of the hind legs above the hocks (see text-fig. 12, b).

A third (Irtish) race, from farther north in Central Asia, has been described by Mr. Walter Rothschild² as *C. sibirica lydekkeri* (see text-fig. 12, a).

In this form (which is also represented by specimens in the winter coat), the light saddle is reduced to a still smaller size than in the last, and the light nape-patch is likewise smaller, and separated by a longer interval from the saddle; the brown tail is bordered with white, and there are also small patches of white on the buttocks adjacent to the tail; the whole of the rest of the upper-parts, as well as the limbs and under-parts, are brown, of a somewhat lighter shade than in the Baltistan race.

Finally, we have what I take to be the typical race of the species, as represented in the British Museum by two mounted male examples in the winter coat, one of which is from the Thian Shan, and the other from Siberia. These specimens have the whole of the upper-parts uniformly coloured, the tint being a full brown in the one first mentioned, but somewhat lighter in the second. Both are further distinguished by the circumstance that the whole of the posterior surface of the metatarsal segment of the hind leg is white.

It seems, therefore, that not only are all the aforesaid four races perfectly easy of definition, but that, so far as coloration is concerned, there is a transition from the Kashmiri to the Thian-Shan form; the one being the lightest, and the other the darkest of the four.

And in this connection it may be remarked that the light-

¹ Great and Small Game of India, Burma, and Tibet, p. 101 (1900).

² Novitates Zoologicae, vol. vii. p. 277 (1900).

coloured Kashmir race of the Asiatic Ibex inhabits the great Snowy Range of the Himalaya, where the snowfall is heaviest. The darker Baltistan Ibex, on the other hand, is a dweller in a district where the fall of snow is less; while the Thian-Shan and Siberian race, at least in part of its habitat, is found in arid districts where the snowfall is still more limited. It would thus seem probable that the type of coloration characteristic of each of the four forms of the Asiatic Ibex mentioned above is directly correlated with the environment of each particular race.

3. Description of a new Freshwater Crustacean from the Soudan; followed by some Remarks on an allied Species.
By Dr. J. G. DE MAN, of Ierseke, Zeeland, Holland.

[Received January 21, 1901.]

(Plate X.)

A male specimen of a Crab from the Bahr-el-Gebel, in the Soudan, obtained by Capt. S. S. Flower, F.Z.S., in April 1900, has been sent to me for examination. Though apparently belonging to a species not yet described, it was, for the sake of certainty, sent successively to Prof. Pfeffer at Hamburg and to Prof. Hilgendorf at Berlin, who both informed me that in their opinion it represented a new species. I therefore venture now to describe it as such.

The carapace is very wide, the greatest breadth, just in the middle between the postfrontal crest and the transverse groove separating the mesogastric and urogastric regions from one another, being in proportion to the length as 5 : 3. The carapace is rather strongly convex from before backwards, and somewhat convex transversely. The prominent and sharp postfrontal crest extends to the anterolateral margins much as in *Potamon (Potamonautes) aubryi* A. M.-E., a type specimen of which, a male from the Gaboon, was kindly sent me by Prof. Bouvier. The postfrontal ridge is interrupted by the mesogastric suture, that appears roof-like ("dachförmig," Hilgendorf, 'Die Land- und Süßwasser-Dekapoden Ostafrikas,' 1898, p. 5). From this suture the crest proceeds sinuously towards, but without uniting with, the lateral margin of the cephalothorax, a narrow suture remaining between the lateral margin and the lateral extremity of the crest, and this lateral extremity for a very short distance curves backwards (Plate X. fig. 3). In *Potamon aubryi* A. M.-E., on the contrary, the postfrontal ridge unites with the lateral margin of the carapace. When the cephalothorax is looked at from above, the postfrontal crest appears quite smooth, only a few crenulations being observed near the lateral extremities. In a front view (fig. 2) the free edge of the ridge appears finely crenate, the crenulations slightly, though rather irregularly, increasing in size towards the lateral

Fig. 3.



Fig. 1.

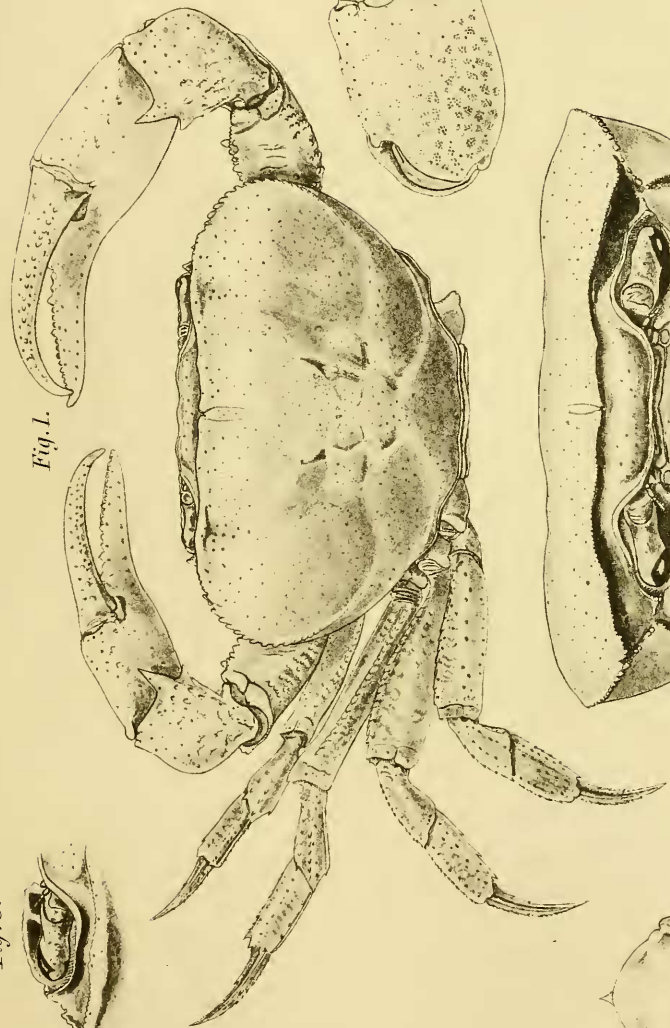


Fig. 6.

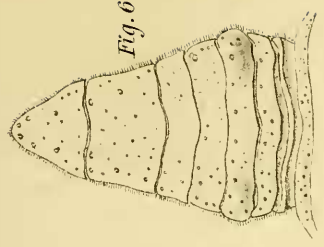


Fig. 7.



Fig. 4.



Fig. 2.

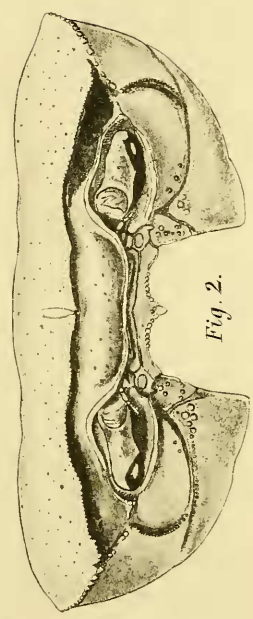


Fig. 5.



extremities; but between the orbits the crest appears smooth. The mesogastric suture, 6 mm. long, does not extend to the middle of the space between the postfrontal crest and the transverse groove limiting the mesogastric and the urogastric regions from one another; and this groove, visible immediately behind the middle of the carapace, is very shallow and hardly distinguishable. A little further backwards a similar shallow groove is observed separating the urogastric area from the cardiac. The lateral grooves of the H-shaped figure are somewhat deeper, and likewise the two >-shaped grooves that bound the anterior cardiac region laterally. The lateral portions of the cervical suture, which in other species run obliquely forward and outward, are quite indistinct in *Potamon floweri*; their direction, however, is still indicated by impressed punctures, that are somewhat larger than the minute punctures scattered on the upper surface of the carapace; the latter are very fine, only distinguishable by means of a magnifying-glass, and rather few in number.

The antero-lateral margins of the carapace are strongly arcuate, almost semicircular, bulging out very much laterally; they extend as far beyond the external orbital angles as the breadth of the orbits. They are defined by a distinctly granulated line that extends backwards as far as the urogastric area. The postero-lateral margins are rounded and smooth and appear very slightly concave, when the carapace is looked at obliquely from above. An epibranchial tooth is wanting. The granulated line that defines the antero-lateral margins, posterior to the postfrontal ridge, is formed by fifteen or sixteen rather large granules, that are not sharp, gradually decrease in size backwards, and finally disappear. The distance between the epibranchial angles measures four-fifths, and that between the extraorbital angles about two-thirds of the width of the carapace.

The front is somewhat convex longitudinally, but almost straight transversely, and the width of the free border measures one-fourth the breadth of the cephalothorax; the upper surface is smooth, rather closely punctate, and the punctures are slightly larger than those of the upper surface of the carapace. When the latter is looked at from above, the free border of the front appears widely emarginate in the middle; this anterior margin forms very obtuse, though not rounded, angles with the very oblique lateral margins of the front; the latter are somewhat thickened, whereas the transverse external portions of the upper orbital margins are thinner.

The sharp, dentiform, outer angles of the orbits are rather prominent and forwardly directed. Between the extraorbital tooth and the epibranchial angle there is a granulated tooth or prominence immediately behind the groove that separates the suborbital and subbranchial areas from one another; this tooth, however, is a little smaller than the extraorbital tooth.

The postfrontal crest lies far forwards, so that when the carapace is looked at from above a small portion of the upper margin

of the orbits and the granulated tooth between the extraorbital and epibranchial angles are covered and concealed by it. The furrow between the postfrontal crest and the upper margin of the orbits is very concave and deep (Plate X. fig. 2).

The whole upper surface of the carapace is smooth and shining, and presents, under an ordinary lens, a very fine punctuation, but is nowhere granulated. The orbits (fig. 2) are large, their width measures three-fourths of the free border of the front, and they are one and a half times as broad as high. In a front view of the carapace (fig. 2), the somewhat concave external portion of the upper margin of the orbits runs obliquely downwards; whereas the lower margin, which is somewhat punctate but otherwise smooth, has a transverse direction, being but very little arcuate; the lower margin of the orbits shows a deep notch or hiatus just below the extraorbital tooth. The superior margin of the orbits and the free edge of the front are also smooth.

The suborbital area is separated by an arcuate, rather deep sulcus from the subbranchial region; the posterior margin of this groove is granulate or crenate, presenting about twenty rather small crenulations; there are three or four granules on the suborbital area close to the groove that separates it from the branchiostegite, but for the rest this region and the branchial floor also are smooth. The branchiostegite bears a few smooth, rounded granules on its anterior extremity (fig. 2), and the suture that separates it from the subhepatic and subbranchial regions is bordered by a row of granules that gradually grow smaller from before backwards; its anterior part is rather deep.

The epistome is smooth. The median triangular process of its posterior border is large and salient, and its lateral margins have seven or eight coarse granules on each side; the slightly concave external portions of the posterior border of the epistome are smooth and rather sharp, but the median process bears also a few granules on its surface. For the rest the epistome, the basal plate, and the basal joints of the outer antennæ are smooth.

The ischium of the external maxillipede (fig. 4) is smooth, rather coarsely punctate, and has a deep furrow that does not reach to the anterior margin of this joint but ends just behind it; it runs distinctly somewhat closer to the internal than to the external margin, and almost parallel with the former; the merus-joint is also smooth and finely punctate, though somewhat more coarsely on the thickened posterior margin.

The sternum shows a fine, not close punctuation, but is for the rest smooth; quite anteriorly a transverse groove unites the postero-external angles of the ischium-joints of the outer foot-jaws with one another. Along the insertion of the chelipedes the lateral margin of the sternum is thickened or raised, just as in *P. infravallatum* Hilg. (Hilgendorf, l. c. fig. 2 a).

The male abdomen (fig. 6) resembles that of *P. suprasulcatum* Hilgendorf (l. c. fig. 5 a). The terminal segment is triangular with obtuse extremity; the lateral margins are somewhat concave

posteriorly, and the posterior margin is one-third longer than the length of this segment. The penultimate segment is just as long as the terminal, and trapezoidal; the anterior margin is in proportion to the posterior as 4:5, and the lateral margins are a little concave. The abdomen is smooth, punctate, especially near the anterior margin of the segments.

The chelipedes (Plate X. fig. 1) are unequal, the right being the larger. The merus of the right chelipede extends but little beyond the lateral margin of the carapace. The upper margin is covered, except at the base, with transverse tubercular rugosities, and on the inner surface, close to and parallel with the smooth proximal part of the upper margin, is seen a row of six or seven small rounded tubercles that decrease in size anteriorly; this row reaches almost to the middle of the arm, and next to each of the first three tubercles there exists a much smaller tubercle. The anterior edge bears a double row of rounded tubercles; the internal row is formed by nine or ten that are not contiguous to one another; the external series bounding the anterior surface of the joint consists of about twice as many tubercles, but these are smaller, unequal, and contiguous to one another. About 2 millimetres from the anterior margin there is, on the anterior surface near the carpal articulation, a somewhat larger tubercle, with convex sides and rather a sharp point; around it several smaller granules are distributed, and a row of five or six larger ones extends from this tubercle to the lower margin of the arm. The lower margin bears along its whole length a row of fourteen or fifteen rounded smooth tubercles, that slightly increase in size distally and are somewhat larger than those of the anterior margin of the joint. The outer surface is finely punctate, but otherwise smooth. The carpus is a little tubercular along its internal margin, behind the acute, slightly depressed spine at the inner angle; beneath the latter there is another spine, only half as large and making a right angle with the larger. A little behind this smaller spine, on the lower border of the inner surface, there is a trace of a third in the form of a small blunt tubercle. The upper and outer surface of the wrist is punctate and smooth. The larger hand (fig. 7) resembles that of *P. hilgendorfi* Hilgendorf (*l.c.* fig. 3). It is almost exactly as long as the cephalothorax is broad, and the fingers, that are somewhat less gaping than on the quoted figure 3, measure three-fifths of the whole length of the hand. The palm, near the articulation of the fingers, is about as high as it is long, measured horizontally; it is somewhat granular along the inner margin of its upper surface, but for the rest it appears smooth and shining; by means of a lens a fine punctation is, however, observed, the punctures being disposed partly in longitudinal rows. The internal surface is also smooth, only a few granulations are seen close to and on its lower border, but these granulations are not visible when the hand is looked at from the outer side. The rather strongly compressed fingers are somewhat bent inward; they are regularly tapering and end in

rather sharp, curved extremities that cross one another. The dactylus is somewhat granular along the inner border of its upper surface, but for the rest both fingers appear smooth and shining externally; they are not furrowed, but each finger is marked with two or three longitudinal rows of small impressed punctures. On the inner surface, however, the dactylus appears at base distinctly furrowed just beneath the upper margin, but this groove also gradually changes, on the middle of the finger, into a row of punctures; the immobile finger shows likewise on its inner surface a rather shallow longitudinal furrow that extends almost to the extremity. The dactylus is armed with about 20 or 21 small teeth, the fifth of which is the largest; the first tooth is but little smaller, the three following gradually decrease in size; beyond the fifth 15 or 16 very small teeth extend nearly to the pointed tip, two or three of them being a little larger than the remaining. The immobile finger bears also 21 small teeth, the sixth of which is the largest and nearly of the same size as the fifth tooth of the dactylus. The first four gradually increase in size, the fifth is quite small, beyond the sixth there are three or four teeth smaller than the sixth, slightly decreasing in size and separated from one another by two or three very small teeth. The latter appear on both fingers, are somewhat compressed, with a straight or slightly arcuate upper edge; the larger teeth are more pointed.

The smaller chela measures four-fifths of the other, but fully agrees with it in shape and characters.

The ambulatory legs are of moderate length, those of the last pair being little longer than the cephalothorax is broad. The meropodites of the last pair are exactly three times as long as broad, also those of the penultimate pair, which are 20 mm. long and $6\frac{2}{3}$ mm. broad. Along their anterior edge the meropodites are covered with depressed acute granules, and they appear a little granular on their outer surface, especially near the anterior margin, except those of the last pair, which are quite smooth. The following two joints are likewise beset, on their fore edge, with small acute teeth or granules, and a few occur on the posterior margin of the propodites. The slender and slightly arcuate dactylopodites taper regularly towards their pointed tips, and are longitudinally ridged both on their outer and inner surfaces. Those of the second and third pairs are furnished, at the base of their posterior margin, only with one spinuliform tooth, those of the fourth and fifth pairs with two or three; several spinuliform teeth are observed along the anterior edge of these joints.

In colour the cephalothorax is of an olive-green, that is lighter on the gastric region and on the sternum than elsewhere. The postfrontal crest, the margins of the orbits and of the front, the granules of the antero-lateral margin, and the tooth of the epistome are yellow. The chelipedes are greenish yellow, the ambulatory legs reddish yellow.

Potamon (Potamonautes) aubryi H. M.-E. is a different species.

The carapace is somewhat less enlarged and, according to A. Milne-Edwards, "aplatie transversalement" (in the specimen that lies before me the upper surface of the carapace is broken!). The postfrontal crest shows different characters. When the carapace is looked at from above, the whole upper margin of the orbits, the whole extraorbital tooth, and also that between the latter and the small epibranchial tooth remain visible. The postfrontal crest is somewhat obliquely bent backwards a little beyond the outer angle of the orbits, and unites with the antero-lateral margin, which shows here a very small, granuliform, epibranchial tooth. The extraorbital tooth is *larger*, slightly concave, obtuse, directed forward, and its outer margin is slightly convex and makes a right angle with the upper margin of the orbits. The distance between the outer angle of the orbits and the epibranchial tooth is proportionately *longer* than in *Potamon floweri*, namely almost as long as the orbits are broad; the tooth between the outer angle of the orbits and the epibranchial tooth is *much longer* and has a different shape. This tooth is *longer*, but lower, less salient than the extraorbital tooth, its outer margin is slightly arcuate and its very short *anterior* margin measures only one third the length of the outer margin. The granulations of the antero-lateral margin are *smaller* and *less prominent* than in the new species from the Soudan. The lower margin of the orbits runs almost transversely in *P. floweri*, but somewhat obliquely upwards in *P. aubryi*. The sternum of the male is *not thickened* along the insertion of the chelipedes. The abdomen of the male has a different form. The terminal segment measures only two-thirds of the penultimate, and its length measures two-thirds of the width of its posterior margin. The penultimate segment is, in the specimen of *Pot. aubryi* lying before me, 9 mm. long, the anterior margin measures $9\frac{1}{4}$ mm., the posterior 12 mm., namely the straight line that unites its lateral angles, the margins being concave: the penultimate segment is as long as its anterior margin is broad.

The tubercles with which the margins of the meri of the chelipedes are furnished are, in *P. aubryi*, smaller, less prominent, and the tubercle on the under surface of these joints near the carpal articulation appears as a rounded granule, scarcely larger than those that surround it. The fingers are *somewhat shorter* in proportion to the length of the palm, and the dactylus is not granulate on its upper margin. The meropodites of the ambulatory legs are a little more enlarged, those of the fifth pair are 20 mm. long and $7\frac{1}{2}$ mm. broad; the dactylopodites finally present one spinule more on their posterior margin.

Potamon (Potamonautes) pelii Herklots, from the Gold Coast, is also a different species. A young male, type, from the Leyden Museum, is lying before me. The carapace is *much less* enlarged; the postfrontal crest runs otherwise, as each half does not extend from the mesogastric suture, transversely outward, but somewhat obliquely backward; the postfrontal ridge, as in *P. aubryi*, unites

with the antero-lateral margin of the carapace, and this antero-lateral margin is *very faintly crenulate*; the granules are much less prominent than in the Soudan species. The postfrontal crest is situated more backwards, so that in this species also the upper margin of the orbits, the extraorbital tooth, and that between the latter and the epibranchial tooth are visible when the carapace is looked at from above. The extraorbital tooth has about the same shape as in *Potamon aubryi*, but the tooth between it and the epibranchial one is much smaller. The orbits have a different shape; there is no hiatus near the outer angle, the lower edge of the extraorbital tooth making only an obtuse angle with the lower margin of the orbits. The distance between the inner angle of the infraorbital margin and the front is in *Potamon pelii* slightly larger, but in *Pot. floweri* a little shorter than half the height of the orbit.

The sternum of the male is not thickened near the insertion of the chelipedes, and the male abdomen is also different, the penultimate segment being just as long as its anterior margin is broad.

I will not describe the legs, the specimen being still young, but they also do not fully agree with those of *P. floweri*.

Measurements of *Potamon floweri* in millimetres:—

	♂.
Width of the cephalothorax	49½
Length of the cephalothorax	30
Distance between the extraorb. angles	31
Distance between the epibranchial angles	39
Breadth of the anterior margin of the front	12½
Distance, in the middle, between the anterior margin of the front and the postfrontal crest ..	4¼
Height of the orbits	6
Breadth of the orbits	9¼
Distance between the extraorbital and the epibranchial angle	5½
Breadth of the posterior margin of the cephalothorax	14½
Distance between the anterior margin of the front and the transverse groove that separates the mesogastric region from the urogastric	16
Length of the terminal segment of the abdomen ..	6
Length of the penultimate segment	6¼
Breadth of the anterior margin of this segment ..	8
Breadth of the posterior margin	10½
Length of the larger chela	44
Length of the fingers	27
Height of the palm at the articulation of the fingers	17
Length of the smaller chela	35½
Length of the fingers	22
Height of the palm at the articulation of the fingers	12

Length of the legs of the last pair	53
Length of the meropodites of these legs	17
Breadth of the meropodites of these legs	5 $\frac{3}{4}$
Length of the dactylopodites	11
Thickness of the cephalothorax	21

Remarks on Potamon (Potamonautes) hilgendorfi Pfeffer.

Prof. Pfeffer, of the Naturhistorisches Museum of Hamburg, was so kind as to present me with two type specimens of *Telphusa hilgendorfi* Pfeffer, both males from Ungün. As Pfeffer's description ('Uebersicht der von Herrn Dr. Fr. Stuhlmann in Aegypten, auf Sansibar und dem gegenüberliegenden Festlande gesammelten Reptilien, Amphibien, Fische, Mollusken und Krebse,' Hamburg, 1889, p. 32) is very short, the following remarks will, I think, be welcome.

The larger specimen has lost its chelipedes; in the other both are present, but Dr. Pfeffer had added two *detached* chelipedes, that, as regards their size, should belong to the larger male. In the first place I will remark that, as Pfeffer likewise writes to me, the true *Pot. hilgendorfi* Pfeffer is a *different species* from that which has recently been described under the same name by Hilgendorf ('Die Land- und Süßwasser-Dekapoden Ostafrikas,' 1898, p. 9, fig. 3), and which inhabits the country around Kilimanjaro.

The cephalothorax of both males is *depressed*, especially behind the cervical suture. The gastric region appears, however, very slightly arcuate, both transversely and from before backwards. Hilgendorf, on the contrary, describes the cephalothorax of his species as "deutlich gewölbt." In Hilgendorf's species the antero-lateral margin of the carapace is described as extending laterally beyond the outer orbital angle somewhat farther than the orbits are broad, but in the type specimens of *Pot. hilgendorfi* Pfeffer they extend laterally *somewhat less than the orbits are broad*. In the species described by Prof. Hilgendorf the lateral portions of the cervical suture are *indistinct* and invisible; in Pfeffer's types, however, they are *deep* and *distinctly developed*, though not reaching to the postfrontal crest. In *both* species an epibranchial tooth is *wanting*. That part of the lateral margin which is situated between the rather acute extraorbital angle and the lateral extremity of the postfrontal crest is *very oblique*, distinctly granulated, and makes a right angle with the upper margin of the orbits; in Hilgendorf's species, on the contrary, the outer orbital angle is described as "stumpfwinklig." In the young male the lower margin of the orbits presents no trace of a hiatus; but just below the extraorbital angle in the larger male I observe a quite shallow incision only on the left side; in the species from Kilimanjaro, however, the incision is small, but usually deep.

The antero-lateral margin, the postfrontal crest, and the orbital margins are distinctly granular or crenate, the postfrontal crest is rather prominent and only interrupted by the mesogastric suture;

it extends laterally to the antero-lateral margin. The lateral margins of the front, which is strongly deflexed, are very oblique in both males and curve regularly into the anterior margin, which is slightly emarginate in the middle; the upper surface of the front is finely granular and appears a little concave in the middle. The anterior half of the gastric region is distinctly granulate, and the lateral parts of the upper surface show the usual finely-granulate, transverse rugæ. The rest of the upper surface is smooth and punctate. The suborbital area is finely granulate and separated from the branchial floor, which is covered with short, transverse, granulate rugæ, by a rather shallow groove; this groove, however, is bordered by a finely-granulate line. The pleural suture limiting off the subhepatic and subbranchial regions from the branchiostegite is defined anteriorly by two granulate lines, just as in *P. suprasulcatum* Hilg.

The outer foot-jaws are furnished with a *distinct* furrow on the ischium-joint in Hilgendorf's species; but in the true *P. hilgendorfi* Pfeffer the "ischial line" is completely *wanting*, at least in the two males lying before me.

The carpus of the anterior legs is covered above with very fine granulate rugæ, and is armed at the inner angle with a *conical* tooth, beneath which a much smaller one is seen. The immobile finger of the chelipedes shows a deep longitudinal groove a little below the middle of its outer surface, and above this groove still another one that is less deep; the outer surface of the dactylus is also marked with two longitudinal grooves, the lower of which is, however, rather shallow. Pfeffer describes these furrows as "einen breitem und einen schmalern Längseindruck." In the species that was described by Hilgendorf there are *no furrows* on the fingers, at least none on the immobile. One observes on the outer surface of the palm very short, vertical, finely-granulate lines that gradually pass into very fine granules towards and on the fingers.

Measurements of the two specimens of *Potamon hilgendorfi* Pfeffer in millimetres:—

	♂.	♂.
Greatest width of the carapace	26	14
Length of the carapace	19	10 $\frac{1}{2}$
Distance between the extraorb. angles ..	18 $\frac{1}{2}$	10 $\frac{3}{4}$
Breadth of the anterior frontal margin ..	8	4 $\frac{1}{2}$
Length of the front, in the median line of the cephalothorax	2 $\frac{1}{4}$	1 $\frac{1}{2}$
Thickness of the carapace	9	5
Breadth of the orbits	5	3
Height of the orbits	3 $\frac{1}{4}$	1 $\frac{3}{4}$
Length of the meropodites of the pen- ultimate pair	12	7 $\frac{1}{2}$
Breadth of these meropodites	4	2 $\frac{3}{4}$
Length of the meropodites of the fifth pair	10 $\frac{1}{2}$	6
Breadth of these meropodites	4 $\frac{2}{5}$	2

The measurements of the detached chelipedes are the following: of one of them the palm and the fingers are respectively $8\frac{1}{2}$ mm., the height of the palm at the articulation of the dactylus measures $7\frac{1}{2}$ mm.; in the other leg the palm is $7\frac{1}{2}$ mm. long, and 7 mm. high at the articulation of the fingers, which measure 9 mm.

I have also before me a type specimen of *Potamon* (*Potamonautes*) *cristatum* A. M.-E., from the Paris Museum, a species the habitat of which is still unknown (A. Milne-Edwards in Nouv. Archives du Muséum, t. v. p. 180, pl. xi. figs. 1 & 1 a). As this species is still insufficiently known, I will compare it with *P. hilgendorfi* Pfeffer.

The carapace of *P. cristatum* appears somewhat longer in proportion to its width than that of *P. hilgendorfi*, and the antero-lateral margins project less laterally, so that the cephalothorax is not so wide. The upper surface appears a little convex from before backwards and the lateral portions of the cervical suture are completely wanting, but the median semicircular part of it is distinct though not very deep. The postfrontal crest passes in a somewhat sinuous line to the lateral margin: that of *P. hilgendorfi*, however, in an almost straight line. The gastric region is also anteriorly, as everywhere, smooth, without granulation. The front has the same form in both species, but that of *P. cristatum* appears somewhat broader in proportion to the distance between the external orbital angles. The antero-lateral margins are more finely granulate than those of *P. hilgendorfi* Pfeffer, and that part which is situated between the extraorbital and epibranchial angles appears in *P. cristatum* less oblique, a little arcuate, and though not toothed makes a distinct angle with the postfrontal ridge when the cephalothorax is looked at from above, whereas in *P. hilgendorfi* Pfeffer this part passes without any interruption into the rest of the margin.

The lower margin of the orbits fully agrees in both species, for also in *P. cristatum* there is no incision or hiatus near the outer angle. In *P. cristatum* the ischium-joint of the outer foot-jaws is distinctly furrowed, and this groove runs somewhat closer to the inner than to the outer margin.

The suborbital and subbranchial regions, together with the grooves that define them, fully agree in both species.

The chelæ of the male of *P. cristatum* are of equal size and shape. The fingers are somewhat gaping at base, whereas those of *P. hilgendorfi* Pfeffer are in contact throughout their length; they are distinctly longer than the palm and deeply furrowed. On the outer surface of the immobile finger two deep grooves are observed near one another, on that of the dactylus three or four. These furrows are less deep in *P. hilgendorfi* Pfeffer. The meropodites of the ambulatory legs of *P. cristatum* finally are more enlarged.

Measurements of the type of *Potamon cristatum* A. M.-E. in millimetres:—

Greatest breadth of the carapace	$16\frac{1}{2}$ ♂.
Length of the carapace	13

Distance between the extraorb. angles	13 $\frac{3}{4}$
Width of the free border of the front	6
Length of the front in the middle	14 $\frac{5}{8}$
Thickness of the carapace	6
Breadth of the orbits	3 $\frac{3}{4}$
Height of the orbits	2 $\frac{1}{4}$
Length of the chelæ	8 $\frac{3}{4}$
Length of the fingers	4 $\frac{3}{4}$
Height of the chelæ at the articulation of the dactylus	3 $\frac{1}{5}$
Length of the meropodites of the penultimate pair	8 $\frac{1}{2}$
Breadth of these meropodites	3 $\frac{3}{5}$

EXPLANATION OF PLATE X.

- Fig. 1. *Potamon (Potamonautes) floweri*, n. sp. $\times 1\frac{1}{4}$.
 2. Front view of the cephalothorax. $\times 1\frac{2}{3}$.
 3. The left orbit and the surrounding part of the upper surface, showing a portion of the postfrontal crest and the tooth between the extra-orbital and epibranchial angles, viewed from above. $\times 1\frac{2}{3}$.
 4. Outer foot-jaw. $\times 1\frac{2}{3}$.
 5. Anterior part of the sternum and terminal joint of the abdomen, showing the thickened ridges near the insertion of the chelipedes. $\times 1\frac{2}{3}$.
 6. Abdomen. $\times 1\frac{2}{3}$.
 7. Larger chelæ. $\times 1\frac{1}{4}$.

4. A Contribution to the Myology and Visceral Anatomy of
Chlamydophorus truncatus. By R. H. BURNE, B.A.,
 F.Z.S., Anatomical Assistant in the Museum of the
 Royal College of Surgeons.

[Received February 1, 1901.]

(Text-figures 13-20.)

The anatomy of *Chlamydophorus* has received so much attention at the hands of various anatomists that the following notes of the dissection of a specimen¹ need some apology.

This small Armadillo is not only of extreme rarity, a fact that in itself would warrant as many descriptions of its anatomy as possible, but in certain of its features—particularly the dermal armature—is so remarkably aberrant, that the determination of its relation to the other Edentates becomes a matter of peculiar interest. There seems little doubt that, from their general similarity of structure, the Armadilloes should all be grouped within one family, and that, within this family, *Chlamydophorus* lies some-

¹ I owe the opportunity of dissecting this specimen to the kindness of Mr. F. W. Lucas to whom it belonged, and of Prof. Stewart who entrusted me with it.

where in the neighbourhood of the subfamily *Dasypodinae*—nearest of all probably to the genus *Dasypus*; although, on account of its peculiar armature, it requires to be placed in a separate subfamily of its own—the *Chlamydephorinae*. A third subfamily is occupied by the genus *Tatusia*, distinct in many important features from both *Dasypodinae* and *Chlamydephorinae*. Such, in brief, is the position assigned to *Chlamydephorus* by Flower¹; but in the settlement of this position there has been in Macalister's well-known monograph² a discordant note. This memoir is mainly devoted to an exhaustive description of the myology; and as the result of a very careful comparison with a large number of other Edentates, the author concludes that "the position of *Chlamydephorus* will be seen from the foregoing description to be plainly among the *Dasypodidae* and very close to *Tatusia*."³ Now it is well known that in most of its viscera *Chlamydephorus* shows far more resemblance to *Dasypus* than to *Tatusia*, so that, in view of Macalister's conclusions, any Dasypine muscular features possess considerable importance. The occurrence in my specimen of several features of this kind constitutes the chief excuse for bringing forward this paper, while a minor one consists in the want of clear drawings of the myology of this rare animal and the opportunity that is offered of incorporating with the remarks upon its viscera certain hitherto unnoticed details in the visceral anatomy of *Dasypus*, *Tatusia*, and *Bradypus* that have from time to time come under observation in the Museum work-room of the Royal College of Surgeons⁴.

MYOLOGY.

In addition to the chapter on Myology in Hyrtl's⁵ classical monograph on *Chlamydephorus*, this subject, as mentioned above, has been dealt with in great detail by Macalister. It will be necessary here to describe only those muscles that differ in some way from these previous descriptions; in other cases the name only of the muscle will be mentioned to indicate that its presence was observed.

Panniculus carnosus.—The only part of this muscle seen was a narrow slip (text-fig. 13, *p.c.*)—noticed by both Macalister and Hyrtl—that rises from the head-shield and is inserted into the spine of the scapula superficial to the trapezius.

MUSCLES OF THE HEAD AND NECK.—The muscles of the snout and upper lip are well developed, and agree fairly well with Hyrtl's

¹ Flower: "On the Mutual Affinities of the Animals composing the Order Edentata." Proc. Zool. Soc. 1882, p. 360.

² Macalister: "On the Anatomy of *Chlamydephorus truncatus*." Trans. R. Irish Acad. xxv. 1895, p. 219.

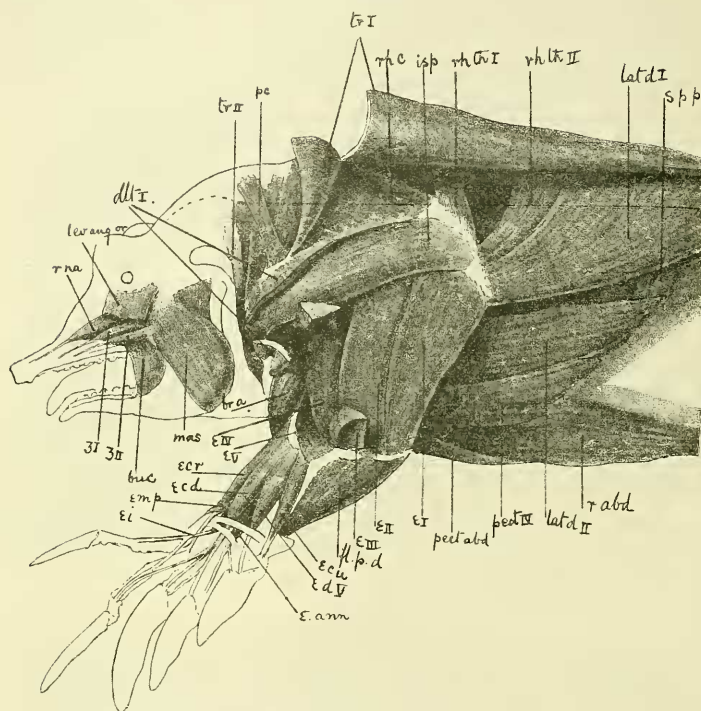
³ The italics are mine.

⁴ These specimens were dissected by the Prosector to the College (Mr. William Pearson).

⁵ Hyrtl: "Chlamydephori truncati...anatomicum examen." Denkschr. k. Akad. Wiss. Wien, ix. 1855, p. 29.

description and entirely so with Murie's account of the face-muscles of *Tolypeutes*¹.

Text-fig. 13.

Muscles of anterior region of *Chlamydochelys truncatus*.

br.a., brachialis anticus.

buc., buccinator.

dl.t. I, scapular deltoid.

e. I, II, III, IV, V, the several heads of the extensor antebrachii.

e.ann., extensor annularis.

e.c.d., extensor communis digitorum.

e.c.r., extensor carpi radialis.

e.c.u., extensor carpi ulnaris.

e.d. V, extensor minimi digiti.

e.i., extensor indicis.

e.m.p., extensor metacarpi pollicis.

fl.p.d., flexor profundus digitorum (hand).

i.sp., infraspinatus.

lat.d. I, II, two parts of latissimus dorsi.

lev.ang.or., levator anguli oris.

mas., masseter.

p.c., panniculus carnosus.

pect. IV, pectoralis quartus.

pect.abd., abdominal part of pectoralis.

r.abd., rectus abdominis.

rh.c., rhomboideus capitis.

rh.th. I, II, two parts of rhomboideus thoracicus.

r.na., retractor naris.

s.p.p., serratus posticus posterior.

tr. I, II, two parts of trapezius.

z. I, II, zygomatici.

¹ Murie. "The Habits, Structure, etc. of *Tolypeutes conurus*." Trans. Linn. Soc. xxx. 1875, p. 105.

Those observed were:—*Levator anguli oris* (text-fig. 13, *lev. ang. or.*), answering to Hyrtl's muscle of the same name (its insertion was destroyed in removing the skin). *Retractor naris* (text-fig. 13, *r. na.*), a large fusiform muscle rising from the anterior margin of the zygomatic arch close to the lower border of the orbit and under cover of the levator anguli oris; it is inserted by a round tendon into the snout. A pair of *Zygomatici* (text-fig. 13, *z. I* & *z. II*), running parallel to one another and to the preceding muscle from the anterior border of the zygoma to the upper lip.

The *Depressor mandibulae* (digastric) was, as in Hyrtl's specimen, absent. Macalister describes a very delicate depressor. Windle & Parsons¹ mention that this muscle was absent in two specimens of *Dasyops* examined by them, although it is described for this genus by Macalister and Cuvier. It is present in *Tatusia*.

The *Stylohyoid* (text-fig. 14, *st. hy.*) answers closely to Hyrtl's description and has (as in his specimen) an expanded tendinous connection with the mylohyoid. A connection of the same kind is of such frequent occurrence among other mammals between the central tendon of the depressor and the mylohyoid, that the absence of this stylohyoid-mylohyoid connection in Macalister's specimen, in which there was a definite depressor, suggests the possibility of a fusion of the depressor with the stylohyoid in Hyrtl's specimen and mine.

The following muscles belonging to this region were also observed: *Buccinator* (text-fig. 13, *buc.*). *Masseter* (text-fig. 13, *mas.*). *Temporalis*. *Pterygoidei*. *Sterno-maxillaris* (text-fig. 14, *st. max.*). *Mylohyoid* (text-fig. 14, *myh.*). *Styloglossus* (text-fig. 14, *st. gl.*). *Sterno-mastoid* (text-fig. 14, *st. m.*). *Cleido-mastoid* (text-fig. 14, *clm.*).

MUSCLES OF THE TRUNK.—The *Trapezius* consisted of two parts: (i) a continuous sheet (text-fig. 13, *tr. I*) with an origin that extends from the occiput to the third lumbar vertebra, and an insertion upon the anterior part of the scapular spine and the base of the acromion: it seems to correspond to the major part of both Macalister's divisions. (ii) a narrow slip (text-figs. 13 & 14, *tr. II*) rising from the occiput anterior to part i. and inserted upon the inner surface of the clavicle on a level with the clavicular origin of the deltoid. This answers to Hyrtl's clavicular trapezius.

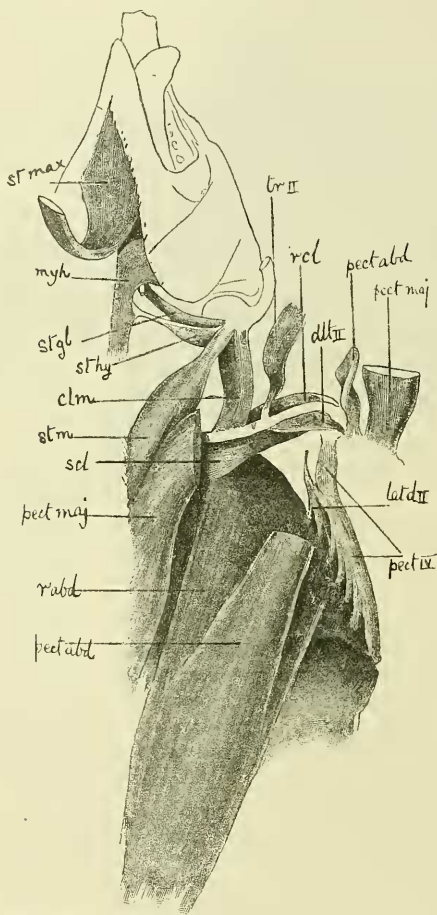
Rhomboideus thoracis (text-fig. 13, *rh. th.*) consisted of two parts, and differed somewhat in arrangement on either side. On the left, both portions were small, separated from one another by a considerable interval, and rose respectively from the neural spines of 1, 2 and 6, 7 thoracic vertebrae. On the right, the posterior part rose from the neural spines of the 6 anterior thoracic vertebrae, and the anterior part from the dorsal mid-line of the neck close along the dorsal margin of the rhomboideus capitis. This latter arrangement corresponds approximately to Macalister's account. The posterior border of this muscle was not, as in *Tatusia*², overlapped by the latissimus dorsi.

¹ Windle & Parsons: "On the Myology of the Edentata." Proc. Zool. Soc. 1899, p. 318.

² Macalister, l. c. p. 236.

The *Latissimus dorsi* agreed with previous accounts in being in two parts. Part I (text-fig. 13, *lat.d. I*) was similar to that described by Macalister. Part II (text-fig. 13, *lat.d. II*) had a more extended

Text-fig. 14.

Muscles of neck and chest of *Chlamyphorus truncatus*.

clm., cleido-mastoid.
dlt. II, clavicular deltoid.
lat.d. II, part of latissimus dorsi.
myh., mylohyoid.
pect. IV, pectoralis quartus.
pect.abd., abdominal part of pectoralis.
pect.maj., pectoralis major.

r.abd., rectus abdominis.
r.cl., retro-clavicularis.
scl., subclavius.
st.gl., styloglossus.
st.hy., stylohyoides.
st.m., sterno-mastoideus.
st.max., sterno-maxillaris.
tr. II, part of trapezius.

origin than in either Macalister's or Hyrtl's specimens. In Macalister's it rose from the last 5 ribs, in Hyrtl's from the last 6, in mine from the last 9. Upon the left side there was a connection between this muscle and the pectoralis quartus (text-fig. 14). I notice that Windle & Parsons¹ state that in the *Dasypodidæ* the *latissimus dorsi* frequently rises from all the ribs posterior to the 3rd or 4th, and when this extensive origin occurs there is a close union with the insertion of the pectoralis forming a more or less complete floor to the axilla—in fact a well-developed "Achselbogen."

Dorso-epitrochlearis (text-fig. 15, *d.epit.*) corresponds with Macalister's description, but is without insertion upon the inner condyle of the humerus. It is attached (as in *Dasypus*)² entirely to the superficial fascia of the forearm.

The *Splenius capitis* was in two parts:—(i) a small triangular muscle rising from the fibrous septum in the dorsal mid-line of the neck and inserted upon the occiput; (ii) a narrow band of muscle, lying in the same plane as part i., with origin from the neural spines of the anterior one or two thoracic vertebræ and inserted upon the skull close above the ear-tube. These two parts agree exactly with the drawing of *Dasypus sexinctus* given by Cuvier and Laurillard³.

I saw no *Rectus thoracis lateralis*, a characteristic Edentate muscle. It was not seen by Hyrtl, and in Macalister's specimen it was very small. Possibly I may have overlooked it although fully aware of its importance.

The *Serratus magnus* rose (as in Hyrtl's specimen) from 8 ribs. In Macalister's it took origin from 7.

The following trunk-muscles were observed, and agreed with Macalister's description:—*Rhomboideus capitis* (text-fig. 13, *rh.c.*). *Serratus posticus posterior* (text-fig. 13, *s.p.p.*). *Trachelo-mastoid.* *Rectus capitis anticus major.* *Rectus capitis anticus minor.* *Longus colli.* *Rectus abdominis* (text-figs. 13 & 14, *r.abd.*). *Levator anguli scapulae.* The *Serratus posticus anterior*—as stated by Macalister—was absent.

MUSCLES OF THE FORE-LIMB.—The *Pectoralis major* (text-fig. 14, *pect.maj.*) had no clavicular origin. In this point it agrees with the pectoralis of *Dasypus* but differs from that of *Tatusia*⁴.

Pectoralis quartus (text-figs. 13 & 14, *pect. iv*) rose from ribs 5–9 (in Macalister's specimen its origin was restricted to 2 ribs); on the right side it was, as described by Macalister, inserted in conjunction with the abdominal part of the pectoralis major, but proximal to it on the left (text-fig. 15). In *Tatusia* the pectoralis quartus rises from 6 ribs, in *Dasypus* from 4⁵.

The *Subclavius* (text-fig. 14, *scl.*), as in Hyrtl's specimen, had no

¹ Windle & Parsons, l. c. p. 322.

² Galton: "The Muscles of the Fore and Hind Limbs of *Dasypus sexinctus*." Trans. Linn. Soc. xxvi. 1870, p. 531.

³ Cuvier & Laurillard, Planches de Myologie, pl. 259. fig. 3. 1, +1.

⁴ Macalister, l. c. p. 240.

⁵ Macalister, l. c. p. 241.

clavicular insertion. In this point it apparently agrees with both *Dasypus* and *Tatusia*.

Like Hyrtl I saw no *coraco-brachialis*. Macalister records a small *coraco-brachialis brevis*.

Extensor antebrachii (triceps).—This muscle was of great size and consisted of four very definite heads—two from the scapula (text-fig. 13, *e.i* & *e.ii*) and two from the humerus (text-fig. 13, *e.iii* & *e.iv*). In their arrangement they agree very well with Galton's description of the extensor of *Dasypus*¹. The two scapular heads rise from the superficial surface of the vertebral half of the posterior border of the scapula. The external humeral head (*e.iii*) rises from the outer and posterior surfaces of the neck of the humerus, and the inner humeral head (*e.iv*) from nearly the entire length of the posterior surface of the humerus; towards its insertion it is easily separable into superficial and deep layers, the deeper part (text-fig. 13, *e.v*) being apparently the representative of an anconeus quartus. In Macalister's specimen there were three scapular heads and one humeral, of which the third scapular head answers in all save its origin to my external humeral. Hyrtl mentions two scapular heads and one humeral.

The flexors of the digits are difficult of interpretation. Macalister describes a *Palmaris longus*, which, although easily recognizable in my specimen (text-fig. 15, *fl.s.*), shows in its distribution to the fingers a great resemblance to a flexor sublimis; it passes over the palmar ossicle as a tendinous expansion, and splits into four fairly definite tendons, that are inserted (after dividing to form an ensheathment for the deep tendons) into the proximal phalanges of digits II, III, IV, V. Galton² gives a description of a superficial flexor in *Dasypus* that tallies very well with this description, and regards it as a combination of *Palmaris longus* and *Flexor sublimis*. I am inclined to apply the same interpretation to this somewhat questionable muscle in *Chlamydophorus*.

I was unable to identify Macalister's flexor sublimis, unless it is the humeral head of the flexor profundus described below.

Flexor profundus digitorum (text-fig. 15, *fl.p.d.*).—This muscle consists of two very definite parts:—(i.) (? Flexor sublimis, Macalister) rises from the inner condyle of the humerus between the flexor carpi radialis and flexor sublimis + palmaris longus, is attached firmly to the inner (radial) surface of the palmar ossicle, and is finally inserted by a long slender tendon to the terminal phalanx of digit I. (ii.) A muscle of great size rising from the whole flexor surface of both radius and ulna and attached by a very stout tendon to the palmar ossicle; from the distal surface of the ossicle four tendons go to the terminal phalanges of digits II, III, IV, V. This part, except that it has no tendon for digit I, seems to agree with Macalister's flexor profundus and flexor pollicis.

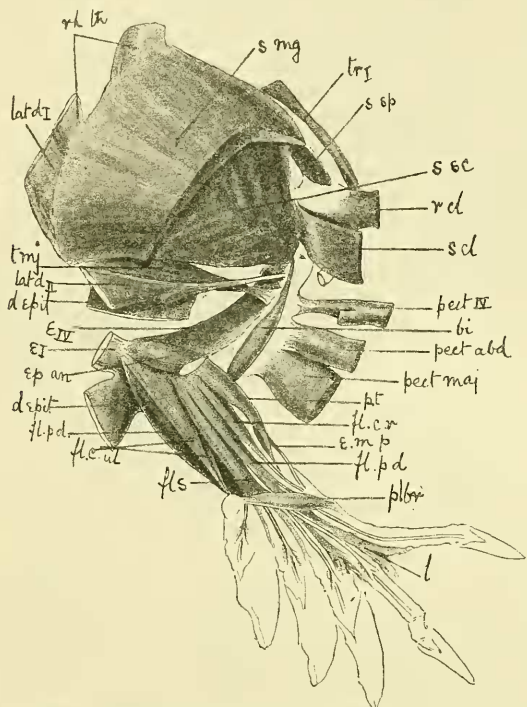
Lumbricals (text-fig. 15, *l.*).—Four slender muscles, rising from the palmar ossicle between the deep flexor tendons and inserted upon the lateral surfaces of the proximal phalanges with the exception

¹ Galton, l. c. p. 539.

² Galton, l. c. p. 545.

of the inner (radial) surface of digit I. These muscles evidently answer to Macalister's 7 short flexors. I notice that Windle & Parsons¹ speak of them as lumbricals, and certainly their origin from the ossicle in the deep flexor tendon and insertion between

Text-fig. 15.



Muscles of inside of fore-limb of *Chlamydophorus truncatus*.

bi., biceps.
d.epit., dorso-epitrochlearis.
e. I, IV, heads of the extensor antebrachii.
e.m.p., extensor metacarpi pollicis.
ep.an., epitrochleo-anconeus.
fl.c.r., flexor carpi radialis.
fl.c.ul., flexor carpi ulnaris.
fl.p.d., flexor profundus digitorum (hand).
fl.s., flexor sublimis + palmaris longus.
l., lumbricalis.
lat.d. I, II, two parts of latissimus dorsi.

pect. IV., pectoralis quartus.
pect.abd., abdominal part of pectoralis.
pect.maj., pectoralis major.
pl.br., palmaris brevis.
p.t., pronator teres.
r.cl., retro-clavicularis.
rh.th., rhomboides thoracicus.
sc., subclavius.
s.mg., serratus magnus.
s.sc., subscapularis.
s.sp., supraspinatus.
t.mj., teres major.
tr. I., part of trapezius.

¹ Windle & Parsons, l. c. p. 334.

the fingers would seem to warrant the name. Lumbricals as described by Macalister I was unable to find, and in this agree with Hyrtl.

Professor Wilson¹, in a critical survey of the myology of the fore-limb—called forth by an examination of the muscles of *Notoryctes typhlops*—notices Macalister's description of these muscles in *Chlamyphorus*, and expresses the belief that probably Macalister's flexor sublimis is part of the flexor profundus, a belief in which I entirely concur. He accepts Macalister's palmaris longus, and finally suggests that Macalister's short flexors are in reality the flexor sublimis still confined entirely to the hand as it is found in *Ornithorhynchus* and Reptiles. This suggestion is one of great interest if well founded, but it is, I fear, not borne out by my dissection.

The two heads of the *Flexor carpi ulnaris* (text-fig. 15, *fl.c.ul.*) were far more separate than in Macalister's specimen; in fact the humeral head formed an independent little muscle with an independent, though very delicate tendon inserted with that of the ulnar head on the pisiform. This muscle seems in Edentates to be liable to considerable subdivision, *e. g.*, in *Cyclothurus* it consists of 4 separate bundles².

The intrinsic muscles of the hand were not observed with sufficient accuracy to warrant any statement, except that, roughly speaking, they agreed with Macalister's description.

There is a superficial muscle (palmaris brevis, text-fig. 15, *pl.br.*) of some size running diagonally across the palm of the hand from the base of the pisiform bone to the base of metacarpal I. This muscle does not appear to have been previously noticed.

The *Extensor carpi radialis* (text-fig. 13, *e.c.r.*) was inserted into the bases of metacarpals II, III by a single tendon situated exactly between them. In Macalister's specimen the tendon was double, and in Hyrtl's single and inserted upon metacarpal II only.

The *Extensor carpi ulnaris* (text-fig. 13, *e.c.u.*) had an origin from the upper part of the ulna, not mentioned by Macalister.

The following muscles were also present:—*Retro-clavicularis* (text-fig. 14, *cl.*). *Deltoid* (text-figs. 13 & 14, *dl.*). *Supraspinatus*. *Infraspinatus* (text-fig. 13, *i.sp.*). *Teres major* (text-fig. 15, *t.mg.*). *Subscapularis* (text-fig. 15, *s.sc.*). *Biceps* (text-fig. 15, *bi.*). *Brachialis anticus* (text-fig. 13, *br.a.*). *Supinator brevis*. *Extensor communis digitorum* (text-fig. 13, *e.c.d.*). *Extensor annularis* (text-fig. 13, *e.ann.*). *Extensor minimi digiti* (text-fig. 13, *e.d.v.*). *Extensor ossis metacarpi pollicis* (text-fig. 13, *e.m.p.*). *Extensor indicis* (text-fig. 13, *e.i.*). The *Supinator longus* was absent.

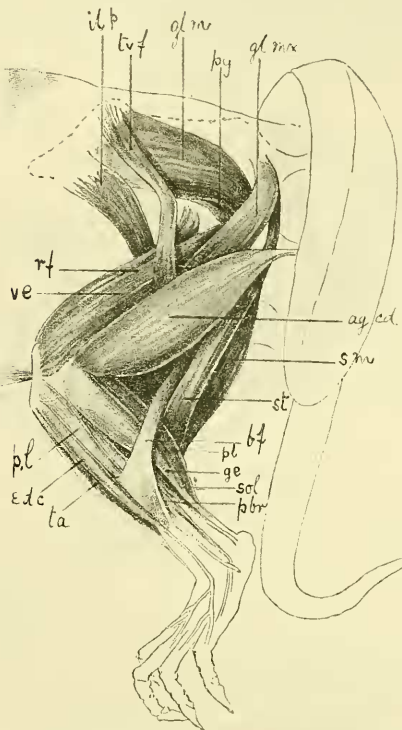
MUSCLES OF THE HIND-LIMB.—*Obturator externus* (text-fig. 17, *obt.ex.*) is a well-marked triangular muscle rising from the ventral border of the obturator foramen, deep to the adductors and inserted by a round tendon upon the femur just proximal to the lesser

¹ Wilson: "On the Myology of *Notoryctes typhlops*." Trans. R. Soc. South Australia, xviii. 1894, p. 44.

² Macalister, l. c. p. 249.

trochanter opposite the insertion of the ilio-psoas. This muscle was not present in Hyrtl's or Macalister's specimen.

Text-fig. 16.

Muscles of outer side of hind-limb of *Chlamydophorus truncatus*.

ag.cd., agitator caudæ.
 b.f., biceps femoris.
 edc., extensor digitorum communis.
 g.e., external head of gastrocnemius.
 gl.m., gluteus medius and minimus.
 gl.m.x., gluteus maximus.
 il.p., ilio-psoas.
 p.br., peronæus brevis and extensor quinti digiti.

p.l., peronæus longus.
 pl., plantaris.
 py., pyriformis.
 r.f., rectus femoris.
 sm., semimembranosus.
 sol., soleus.
 st., semitendinosus.
 t.a., tibialis anticus.
 t.v.f., tensor vaginæ femoris.
 v.e., vastus externus.

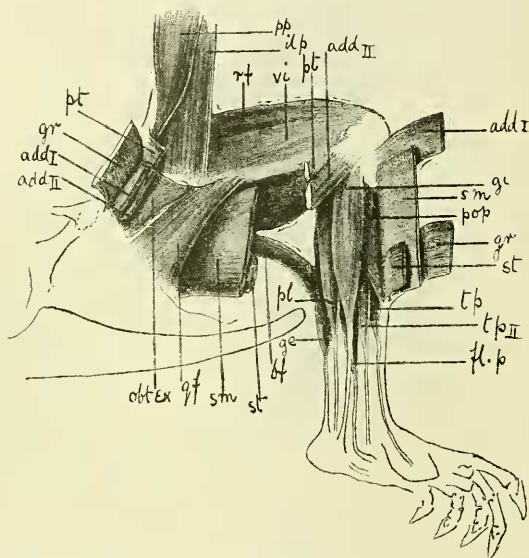
The *Biceps femoris* (text-figs. 16 & 17, *b.f.*) had an insertion upon the fibula as well as the insertion mentioned by Macalister into the superficial fascia of the leg. The *Semitendinosus* (text-fig. 16, *st.*) showed no sign of an insertion.

I saw no *Sartorius* in either leg. Macalister speaks of this

muscle as "wide, thick, and fleshy"¹, so that it is unlikely that it was removed unobserved. Hyrtl says that in his specimen it was incorporated with the adductors.

Rectus femoris (text-fig. 16, *r.f.*) rose, as in *Tatusia* and *Dasypus*², by a single origin from the dorsal brim of the acetabulum. In Macalister's specimen it had the more usual double crigin.

Text-fig. 17.

Muscles of inside of hind-limb of *Chlamydophorus truncatus*.

add. I, II, adductor primus and secundus.
b.f., biceps femoris.
fl.p., flexor profundus (foot).
g.e., external head of gastrocnemius.
g.i., internal head of gastrocnemius.
gr., gracilis.
il.p., ilio-psoas.
obtex., obturator externus.
pl., plantaris.

pop., popliteus.
p.p., psoas parvus.
pt., pectineus.
p.t., pronator teres.
q.f., quadratus femoris.
r.f., rectus femoris.
sm., semimembranosus.
st., semitendinosus.
t.p., tibialis posticus.
t.p. II, tibialis posticus accessorius.
v.i., vastus internus.

Adductor secundus (text-fig. 17, *add. II*) differed from Macalister's description in rising from the pubis superficial to the obturator externus, and not from the ventral support of the sphæroma.

The *Gastrocnemius* and *Soleus* (text-figs. 16 & 17, *ge.*, *gi.*, *sol.*) did

¹ Macalister, l. c. p. 263.

² Macalister, l. c. p. 264.

not differ from previous descriptions, but it may be noted that the component tendons of the tendo Achillis showed no signs of the spiral twist around one another, that seems to occur to a greater or less extent among the generality of mammals¹.

The *Plantaris* (text-figs. 16 & 17, *pl.*), as in *Dasyppus*², has no direct attachment to the heel; its tendon passes through a foramen in the calcaneum (a gutter in *Dasyppus*) and divides in the sole of the foot into separate tendons inserted upon the proximal phalanges and the expanded navicular.

The *Peroneus longus* and *brevis* (text-fig. 16, *p.l.* & *p.br.*) differ from the same muscles in the previously described specimens and in *Tatusia* by respectively rising partly from the knee-cap and external condyle of the femur as in *Dasyppus sevincetus*³. The peroneus longus rises from the outer side of the knee-cap and from the proximal part of the outer surface of the fibula; it is inserted as usual upon the base of metatarsal I.

The *Peroneus brevis* and *extensor brevis* v. rise by a common origin from the external condyle of the femur, the external lateral ligament, and the proximal part of the antero-lateral surface of the fibula. The single belly terminates, in two delicate tendons, inserted respectively on the base of the metatarsal and of the penultimate phalanx of digit v.

In view of the speculations that have arisen concerning the origin of the external lateral ligament as a modification of a femoral tendon of origin of the peroneus longus⁴, one might expect the origin of the peroneus brevis and extensor brevis v from the ligament itself as well as from the femur to throw some light upon the question, but apparently it does not. For, with the facts as they stand, it can be argued with equal propriety that the ligament in question is a structure originally independent of the muscle, but in this case serving as part of its area of attachment, or that it is part of the femoral tendon of origin of the muscle in process of transformation—functionally a ligament but not yet completely divorced from the muscle.

The *Tibialis anticus* (text-fig. 16, *t.a.*) had an origin (not mentioned by Macalister) from the anterior inner border of the fibula. A similar origin is found in *Dasyppus*, *Cyclothurus*, *Bradypus*, and *Choloepus*⁵.

The *Tibialis posticus accessorius* (text-fig. 17, *t.p. II*) took origin from the proximal part of the hollow on the inner surface of the fibula, and was inserted upon the inner surfaces of the astragalus. According to Macalister's description, it rises from the tibia and is inserted on the entocuneiform.

The *Extensor digitorum communis* (fig. 16, *e.d.c.*) sends a tendon

¹ Parsons: "On the Morphology of the Tendo Achillis." Journ. Anat. & Physiol. xxviii. 1894, p. 414.

² Galton, l. c. p. 556.

³ Galton, l. c. p. 559; also No. C 208, Physiol. Series, R. Coll. Surg. Museum.

⁴ Bland Sutton: 'Ligaments, their Nature and Morphology,' 1887, p. 34.

⁵ Macalister, l. c. p. 268. Galton, l. c. p. 558.

to each of the toes; in Macalister's specimen to the four outer toes only.

The following muscles were present and agreed with Macalister's description:—*Tensor vaginæ femoris* (text-fig. 16, *t.v.f.*). *Gluteus maximus* (text-fig. 16, *gl.ma.*). *Agitator caudæ* (text-fig. 16, *ag.cd.*). *Gluteus medius+minimus* (text-fig. 16, *gl.m.*). *Pyriformis* (text-fig. 16, *py.*). *Quadratus femoris* (text-fig. 17, *q.f.*). *Semimembranosus* (text-figs. 16 & 17, *sm.*). *Gracilis* (text-fig. 17, *gr.*). *Pectineus* (text-fig. 17, *pt.*). *Vastus externus* (text-fig. 16, *v.e.*). *Vastus internus* (text-fig. 17, *v.i.*). *Psoas parvus* (text-fig. 17, *p.p.*). *Ileo-psoas* (text-fig. 17, *il.p.*). *Adductor primus* (text-fig. 17, *add.1.*). *Popliteus* (text-fig. 17, *pop.*). *Tibialis posticus* (text-fig. 17, *t.p.*). *Extensor hallucis longus*. *Flexor profundus* (text-fig. 17, *fl.p.*).

In this review of the muscles, it will be noticed that in several particulars this specimen approaches *Dasypus* more nearly than those dissected by Macalister and Hyrtl. One may take as instances:—The extensive origin of part 2 of the latissimus dorsi. The twofold nature of the splenius capitis. The want of a clavicular origin to the pectoralis major. The absence of a direct insertion of the plantaris to the heel, and lastly the mode of origin of the peronei—an origin, so far as I know, hitherto found only in *Dasypus*.

JOINTS.

Temporo-maxillary joint.—This is of a very feeble character with small flattened articular surfaces. It is remarkable for the absence of an interarticular fibro-cartilage. Parsons¹, in his Hunterian Lectures on Mammalian joints, records three examples of temporo-maxillary joint among the lower orders of mammals without an interarticular cartilage (e. g. *Ornithorhynchus*, *Dasypus*, and *Dasypus*). It is interesting to find that *Chlamydomorphus* shares this exceptional character with *Dasypus*.

Shoulder-joint.—There is a stout accessory ligament that passes, superficial to the capsule, from the coracoid process downwards and backwards to the outer surface of the head of the humerus. This ligament is noticed by Hyrtl, and can still be seen attached to his preparation of the skeleton (R. C. S. Osteol. Series, No. 3582), and I only mention it to draw attention to a similar ligament in *Dasypus* and *Tatusia* (R. C. S. Physiol. Series, Nos. B 125, B 126).

THE VISCERA.

On the coarse anatomy of the viscera there is little to be said, for this subject has been dealt with in detail by Hyrtl, and any gaps left in his descriptions have been filled by Macalister and Watson². I shall thus mainly confine my remarks to certain

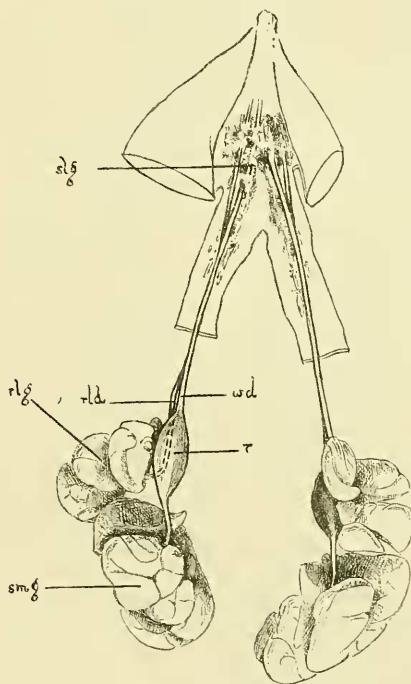
¹ Parsons: "The Joints of Mammals." Journ. Anat. & Physiol. xxxiv. 1899, p. 41.

² Watson: "On the Male Generative Organs of *Chlamydomorphus truncatus*, &c." Proc. Zool. Soc. 1878, p. 673.

details in the salivary apparatus and aortic arch that appear to have escaped observation.

The Salivary Glands.—Hyrtl describes parotid, buccal, and submaxillary glands, but there is also a sublingual gland of considerable size with the usual position and characters. It may be mentioned in passing that Hyrtl's figure of the relations between Stensen's duct and the buccal gland is misleading. He suggests that probably the buccal gland pours its secretion into this duct and figures it as running close along the upper border of the gland. In point of fact there is no connection between the two; Stensen's duct takes quite the usual course across the masseter at a very considerable distance above the buccal gland, while the latter in all probability opens independently into the mouth in the ordinary way.

Text-fig. 18.



Salivary glands of *Dasypus seavinctus*.

r., muscular reservoir.
rl.d., duct of retro-lingual gland.
rl.g., retro-lingual gland.

sl.g., sublingual gland.
sm.g., submaxillary gland.
w.d., Wharton's duct.

With regard to the submaxillary gland there is a feature of some little interest. The secretion is collected (as described by Hyrtl) into two main ducts, each of which receives the secretion of one

of the two lobes into which the gland is divisible. After a short course free of the gland-substance, the ducts are said to open into a spindle-shaped muscular reservoir, from the anterior extremity of which a single duct (Wharton's duct) leads to an opening in the floor of the mouth beneath the tongue. This description is only partially true, for, of the two main collecting-ducts, one only (*i. e.* that coming from the larger and most posteriorly situated lobe of the gland) opens into the muscular reservoir and continues from its anterior extremity to the opening beneath the tongue; the other, although it enters the wall of the reservoir, has no communication with its cavity, but courses down its dorsal margin close beneath the lining epithelium and continues as a separate duct, intimately connected with the first, to an opening beneath the tongue. (It was not seen whether these two ducts opened into the mouth by a common aperture or separately.)

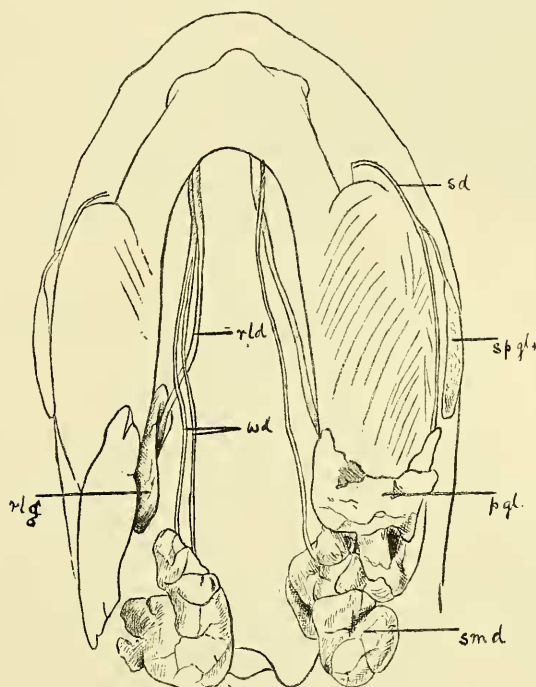
An arrangement of the submaxillary gland and ducts precisely similar to this was found in *Dasyppus sexcinctus* (text-fig. 18), but, owing to the greater size of the creature, the individuality of the ducts was more easily seen. Somewhat similar features were also observed in the Three-toed Sloth (*Bradypus tridactylus*, text-fig. 19). The submaxillary gland in this animal is divisible, as in the above-mentioned Dasypodidæ, into two well-marked lobes each provided with its own duct. The two ducts run side by side (with, however, no muscular reservoir on either of them) to the floor of the mouth beneath the tongue. The duct from the smaller and more anteriorly situated lobe of the gland is remarkable for its large calibre and for the thinness of its walls—in fact at first sight it had very much the appearance of a vein. The duct from the larger and posterior lobe was double throughout its length on the right side, but single on the left. The meaning of the conditions observed in the submaxillary glands and ducts of these three Edentates becomes, I think, clear on reference to a paper by Ranvier¹, in which, in addition to numerous observations of his own, he collects and harmonizes the previously confused statements concerning the relations that subsist between the sublingual and submaxillary glands. It is well known that frequently in Man there occurs a large duct (duct of Bartholini) that arises from a posterior portion of the sublingual gland and runs alongside Wharton's duct to open with it or near it under the tongue. Bartholini himself² described and figured a similar duct in the Lioness, having its gland in close connection with the submaxillary, and Ranvier adds a large number of mammals in which the same gland (called by him Retro-lingual) is found with great constancy. According to Ranvier the retro-lingual gland lies always posterior to the lingual nerve, and for this reason (a somewhat arbitrary one it

¹ Ranvier: "Etudes anatomiques des Glandes connues sous les noms de sous-maxillaire et sublinguale, chez les Mammifères." Arch. de Physiol. xviii. 1886, p. 223.

² Bartholini: De ductu salivali hactenus non descripto observatio anatomica, 1685.

seems¹) cannot be identified with the part of the sublingual gland in connection with Bartholini's duct in Man, although in structure it agrees with the sublingual.

Text-fig. 19.

Salivary glands of Three-toed Sloth (*Bradypus tridactylus*).

p.gl., parotid gland.
s.p.gl., socia parotidis.

s.d., Stensen's duct.

Other letters as in text-fig. 18.

Now, apart from the question of the identification of the retro-lingual gland with part of the sublingual, which does not actually concern us here, there can be no doubt, I think, that the two ducts coming from each submaxillary gland in these Edentates are in reality the ducts of a retro-lingual and submaxillary gland, and that, of the two lobes of the gland, the anterior is from its position the retro-lingual, and the larger posterior lobe the true submaxillary².

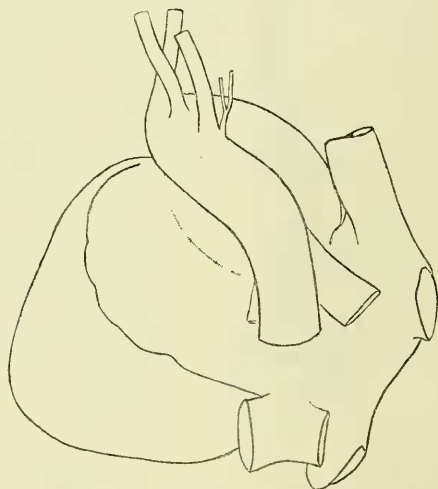
¹ In this connection see Ranvier's figure of the retro-lingual gland of the Pig. in which the anterior end of the gland extends in front of the lingual nerve.

² The tissues were not sufficiently well preserved to allow of microscopic examination.

Before leaving the salivary glands, it may be mentioned that in the Sloth the socia parotidis (text-fig. 19, *s.p.gl.*) is very large and of unusually definite shape. It is a long pear-shaped body situated at some distance dorsal to Stensen's duct, into which it opens by a single duct 9 mm. in length, that emerges from its anterior pointed end.

The Heart.—I have nothing to add to Hyrtl's description of the heart, and I find in two specimens that the great vessels rise from the aortic arch in a manner similar to that previously recorded; but there is a slight peculiarity in the conformation of the arch itself that merits a brief description, not so much for its intrinsic importance in *Chlamyphorus*, as because a similar though exaggerated modification forms a very striking feature in the aorta

Text-fig. 20.

Heart of Three-toed Sloth (*Bradypus tridactylus*).

of the Sloth. The peculiarity in question consists of a marked depression of the transverse part of the arch towards the ventral surface. The ascending aorta is short, and at the commencement of the transverse part bends sharply forward towards the ventral surface of the heart, and then curves round towards the dorsum compressed between the base of the heart and the trachea. The convexity of the arch thus lies in the transverse plane of the heart, instead of approximately in its longitudinal plane as is usually the case. In two other Edentates (*Tamandua* and *Myrmecophaga*) that I have examined, the arch lies in the longitudinal plane as usual, but in the Sloth (*Bradypus tridactylus*) there is a ventral depression of the aortic arch of a most marked character (text-fig. 20). In both cases, the depression appears to be due to the pressure of

the trachea upon the arch, occasioned by the position of the heart, which lies with its longitudinal axis much more nearly at right angles to the long axis of the body than in most mammals.

The *Alimentary Canal* has been already fully described, but in examining this system one is much struck by the great resemblance the different parts bear to the corresponding organs of *Dasypus*. This perhaps is specially the case with the liver, which is almost an exact counterpart on a small scale of that of *Dasypus villosus*. The liver of *Tatusia*, on the other hand, differs materially from those of *Dasypus* and *Chlamydophorus*; it is much rounder and more compact in form; the left lateral lobe shows no great preponderance in size over the rest, and the caudate lobe is very much smaller.

I have nothing to add to previous descriptions of the respiratory or generative organs.

5. Notes on the Broad-nosed Lemur, *Hapalemur simus*.

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[Received January 31, 1901.]

(Text-figures 21-25.)

Some years since¹ I was enabled to add to the existing knowledge of *Hapalemur griseus* by the examination of two specimens that had died in the Society's Gardens. I am now able to compare the facts which I then ascertained with the structure of the only other species of the genus—*H. simus*. The individual which I have dissected was an example deposited in the Society's Gardens by the Hon. Walter Rothschild, M.P., F.Z.S., last year. After living for some months it died of a diseased condition of certain of the lymphatic glands of the abdominal cavity. The spleen also was invaded by pus, but in other respects the carcase showed no pathological conditions. The animal was a female.

Our present knowledge of the anatomy of this Lemur is due to Gray, Jentink, and Milne-Edwards. The species was founded by Gray², who described as well as figured the entire animal; besides external characters, Dr. Gray dealt with and figured the skull and the dentition. So far as they go, the facts set down by Gray do not appear to me to be in want of correction. Later Dr. Jentink again figured³ the skull of *H. simus*, comparing it with that of *H. griseus* by means of other figures. These drawings also seem to me to represent the distinctions between the skulls of the two species accurately. Finally, the late Prof. A. Milne-Edwards in the last issued volume of his and Grandidier's 'Histoire naturelle de Madagascar,' has figured not only the skulls of the two species,

¹ P. Z. S. 1884, p. 391, and *ibid.* 1891, p. 449.

² "Notes on *Hapalemur simus*, &c.," P. Z. S. 1872, p. 829.

³ "On some rare and interesting Mammals," Notes Leyd. Mus. vii. 1885, p. 33.

but the rest of the skeleton and the principal viscera of *Hapalemur simus*. This volume, however, consists merely of the "Atlas"; the corresponding letterpress has not yet, so far as I am aware, been published. I believe that the above list exhausts the memoirs which deal anatomically with *Hapalemur simus* at first hand. I judge that the late Dr. Mivart in writing of "*Hapalemur simus*" should have written "*Hapalemur griseus*," since the structural facts which he uses in the definition of the genus *Hapalemur*¹ are those of *H. griseus* and not those of *H. simus*. The peculiarities of the teeth of the latter, which are plainly enough shown in the bulk of the figures of the skull to which I have already referred, are not included by Dr. Mivart in his generic definitions. As these teeth peculiarities have not yet been emphasized in words, I shall perhaps not be performing an unnecessary task in calling attention to them.

In *Hapalemur simus*, which has a much more truncated as well as a much broader snout than has *H. griseus*, both the incisors are sheltered by the canine so as to be invisible on a lateral view. This state of affairs is correctly figured by Gray². In *H. griseus*, on the other hand, as figured by Mivart in his early paper on the structure of Lemurs³, only the posterior of the two incisors is thus sheltered, the anterior incisor being decidedly in front, though also to the side, of the canine. In a young skull in my possession both incisors are in front of the canine, and in this particular the young *Hapalemur griseus* resembles the adult *Lemur*. At least most species of that genus, for in *Lemur brunneus* (a note by my predecessor Mr. Forbes informs me) the condition is like that of *Hapalemur*. The line of the molars is straighter in *H. simus* than in *H. griseus*, where it is slightly concave inwards—the line of the teeth following that of the palate, which is in that species a little narrowed posteriorly; it is not so in *H. simus*. The molars of the upper jaw in *H. simus* have an additional cusp not found in *H. griseus*; it is the inner posterior cusp, and the molars are thus quadricuspid instead of tricuspid. This seems to me to be a rather important distinction. It is, as I have remarked, correctly figured by previous authors but has not been described. The molars of *H. simus* are larger than the premolars; this is not the case with *H. griseus*, in which species the third premolar is the largest tooth of the cheek-teeth series. In *H. simus* pm. 2 and pm. 3 are subequal in size.

The first point to which I directed my attention was the condition of the forearm. It will be recollected that I was able to show in the case of its congener *H. griseus* that the male was distinguished by the existence close to the hand of a patch of spine-like structures associated with a large gland lying beneath

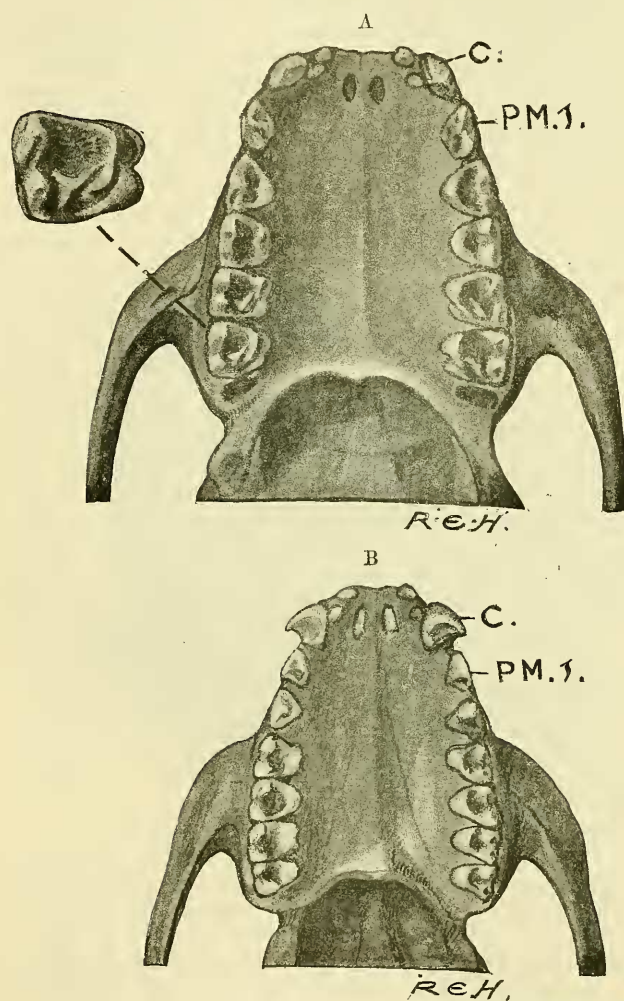
¹ "On *Lepidolemur* and *Cheirogaleus* and on the Zoological Rank of the Lemuridæ," P. Z. S. 1873, p. 500.

² P. Z. S. 1870, p. 830, fig. 3.

³ "Notes on the Crania and Dentition of the Lemuridæ," P. Z. S. 1864, p. 613. See also P. Z. S. 1867, p. 960.

the integument. In the female of *H. griseus* those spines are not present, but, as I was informed by Dr. Jentink and the late Prof. Milne-Edwards, there is a patch of skin which is recognizable

Text-fig. 21.



A. Upper jaw of *Hapalemur simus*. B. Upper jaw of *H. griseus*.

C., canine; P.M. 1., first premolar.

as distinct from the rest of the integument upon the arm. Since I received this information, the arm of this species has been

figured by Milne-Edwards¹. Both of the gentlemen to whom I referred further informed me that in *H. sinus* there were no traces of these peculiar modifications of the skin of the wrist. But in dried skins, structures of this kind might conceivably be missed. I am therefore glad to have the opportunity of stating that in the fresh *H. sinus*, which forms the subject of the present communication, there are no traces at all of any modification of the skin of the forearm such as characterizes *Hapalemur griseus*. These two species are regarded by most systematists as perfectly distinct, though it may be admitted that the general aspect of the two is not very different². Influenced probably by this latter consideration, Mr. Lydekker observed in the 'Royal Natural History' (vol. i. p. 217) that the Broad-nosed Lemur (*H. sinus*) does not appear to be more than a variety of the Gentle Lemur (*H. griseus*). The above-stated facts, even if there were no others, seem to show plainly that the two forms of *Hapalemur* are distinctly entitled to separate specific names. There is one other fact of external structure which distinguishes the present species from its congener. Shortly after my description of the arm-gland and patch of spines upon the forearm of the male *H. griseus*, Mr. Bland Sutton discovered and figured³ in this Lemur and in some others a tuft of long hairs in close proximity to the patch of spines. Since that time I have found a similar tuft of hairs on the arms of mammals belonging to other orders than the Lemures⁴, and have expressed the opinion that they are possibly general in such creatures as use their forearms as grasping or climbing organs. It had appeared to me further, that this tuft of long, often black, hairs, which are quite unmistakable, are not to be looked upon as a sexual character. I was therefore much surprised at being totally unable to detect the faintest vestige of them in the female *Hapalemur sinus* upon which I comment in the present communication. I believe that there is no doubt about their absence; I looked with extreme care for them and removed the skin in order to find—if it were present—the strong nerve-twig which is at least often associated with them in other mammals. This was totally absent. Having by me a number of carefully sexed skins of other Lemurs, I investigated this question further.

In females of *Lemur albifrons*, *L. anjuanensis*, *L. brunneus*, *L. coronatus*, and *L. mongoz* I found a tuft of three or four long hairs upon the forearm shown with perfect distinctness; I also observed the same in males of the species *L. albinus*, *L. brunneus*, *L. albifrons*, and *L. rufifrons*. On the other hand, in a female skin of each of the species *L. mongoz*, *L. nigrifrons*, and *L. anjuan-*

¹ Histoire Naturelle &c. de Madagascar.

² Dr. Gray (P. Z. S. 1872, p. 852) observed that "it has been suggested that the colour of *H. griseus* and *H. sinus* are so alike that they are only the sexes of the same species."

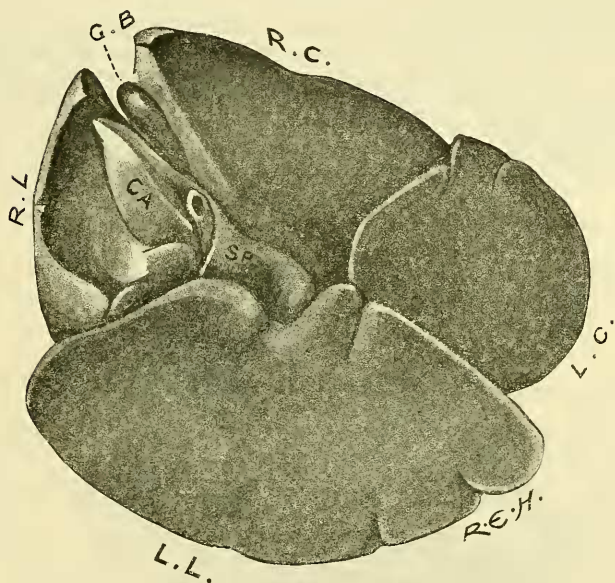
³ "On the Arm-gland of Lemurs," P. Z. S. 1887, p. 369.

⁴ "On the Anatomy of *Bassaricyon*," P. Z. S. 1890, p. 661, and 'Nature,' vol. lxii. p. 523.

ensis, I failed to find these structures. I do not lay much stress upon the value of this observation, since it is less satisfactory to deal with dried skins than with the recently dead animal. But the possibility must be borne in mind that these tactile hairs may be less constant in the female of certain Lemurs than in the male. And that, therefore, the character to which I refer as possibly distinguishing the two species of *Hapalemur*—if it really does distinguish the male from the female in *H. simus*—may not be of great value as a mark of specific difference. The matter must be settled later.

Cæcum.—I noticed certain small, but definite, differences in the viscera of the two species of *Hapalemur*. The alimentary canal

Text-fig. 22.

Liver of *Hapalemur simus*.

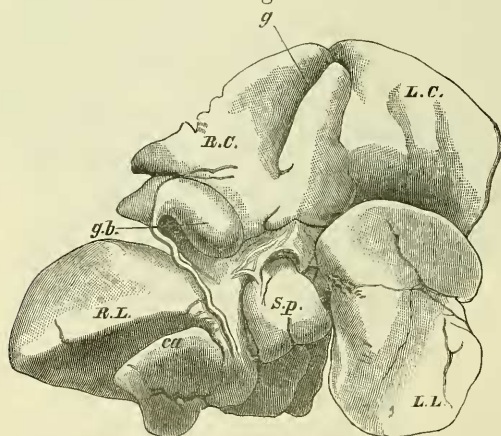
G.B., gall-bladder ; R.C., right central lobe ; R.L., right lateral ; L.C., left central ; L.L., left lateral ; CA., caudate ; Sp., Spigelian.

of *H. simus* seems to be longer in proportion to the body than in the other species. The specimen of *H. simus* which I dissected had a body-length (exclusive of tail) of 14 inches, it being thus not much, if any, larger than *H. griseus*. But the intestinal measurements were as nearly as possible double the length of those of the example of *H. griseus* recorded by myself. In *H. simus* the several lengths were as follows:—Small intestine 4 ft. 9 inches ; large intestine 2 ft. 4 inches. The alimentary

canal of course differs widely in actual lengths in different individuals; but I think that so large a difference as this would be unusual, and may be perhaps looked upon as a valid mark of specific distinction. The second point respecting the alimentary canal concerns the mesenteries which support the cæcum. In most Lemurs, the cæcum is tied to the small intestine by a single anangious fold lying between two bloodvessel-bearing folds, which run on to the large intestine. In *Hapalemur griseus* I found that the median anangious fold was absent. The two lateral folds were quite normal and like those of other Lemuroids. I suggested that the absence of this frenum might conceivably be connected with the shortened cæcum of *Hapalemur*. It is clear that this explanation must fall to the ground, since in *H. sinus* the cæcum is of quite the same form, but it *does* possess the median anangious cæcal frenum.

The liver of *H. sinus* is shown in the accompanying drawing (text-fig. 22, p. 125), which does not altogether agree with the figure given by Milne-Edwards, and may be compared with the annexed sketch of that of *H. griseus* (text-fig. 23), which was published in illustration of my notes upon the anatomy of that Lemur. It will be seen that there are a few small points of difference.

Text-fig. 23.

Liver of *Hapalemur griseus*.

(From P. Z. S. 1884, p. 396.)

g. umbilical fissure. Other letters as in text-fig. 22 (p. 125).

The most salient difference is that the left lateral lobe, instead of being quite small, no larger than the remaining chief lobes of the organ, is quite twice the size of the left central. The right central lobe, moreover, is rather larger than the left central. The gall-bladder has the same anomalous position that it has in *H. griseus*, and in many if not most other Lemurs; the ductus

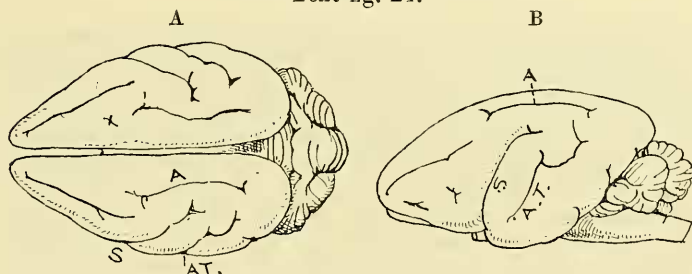
choledochus arises from the end of the gall-bladder which is turned away from the intestine.

The *brain* of this species has been figured by Milne-Edwards; as might be supposed, it hardly differs from that of its congener. Seeing that that of *Hapalemur griseus* again is extremely like the brain of the genus *Lemur*, any differences are scarcely to be looked for. In the brief remarks which follow, the minute divergences in structure between the two species which I record here must be considered to be possibly subject to revision when more abundant material is at the disposal of some anatomist. Since describing the brain of *Hapalemur griseus*, I have come into possession of a second brain of that species; in some respects the second brain differs from that originally described. It is, in the first place, rather larger, a fact which goes some way to removing one apparent difference between the brains of the two species of *Hapalemur*. The following measurements of the three brains of which I shall speak here show that the proportions of length to breadth are much the same in the two species; they are:—

	Length of cerebral hemispheres.	Breadth of cerebral hemispheres.
<i>Hapalemur griseus</i> No. 1	33 mm.	26 mm.
<i>Hapalemur griseus</i> No. 2	35 „	28 „
<i>Hapalemur simus</i>	40 „	31 „

The contour of the brain hardly differs in the two species nor the proportions of the several regions. The accompanying drawing

Text-fig. 24.



Brain of *Hapalemur simus*.

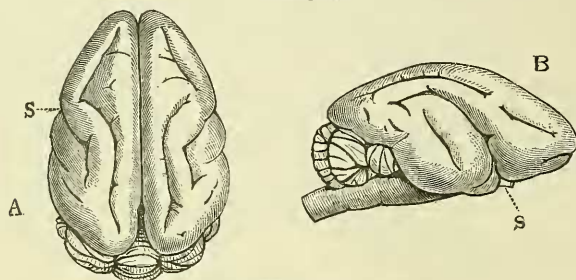
A. Dorsal view. B. Lateral view.

A, supra-angular fissure; S, Sylvian fissure; A.T., antero-temporal.

shows the furrows of the brain of *Hapalemur simus* (text-fig. 24), which differs in some minute particulars from that figured by Milne-Edwards. It will be noticed that the Sylvian fissure is slightly different in this species. The upper end of that furrow does not slope backwards parallel to the angular fissure as it does in *H. griseus*. On the contrary, its tendency is rather to bend forwards; the upper

end is at least slightly hooked. This was more marked upon the right than upon the left side. The olfactory region of the brain was much compressed ventrally in the way which characterizes so many Apes. It presents the appearance of having been squeezed between the fingers while in a plastic condition. The compression seemed to me to be more marked in *H. simus* than in the other species; but this particular feature is sometimes lost during preservation. However, this and the other brains were most carefully extracted from the skull; they have been but very slightly altered in shape during the process of hardening with alcohol.

Text-fig. 25.

Brain of *Hapalemur griseus*.

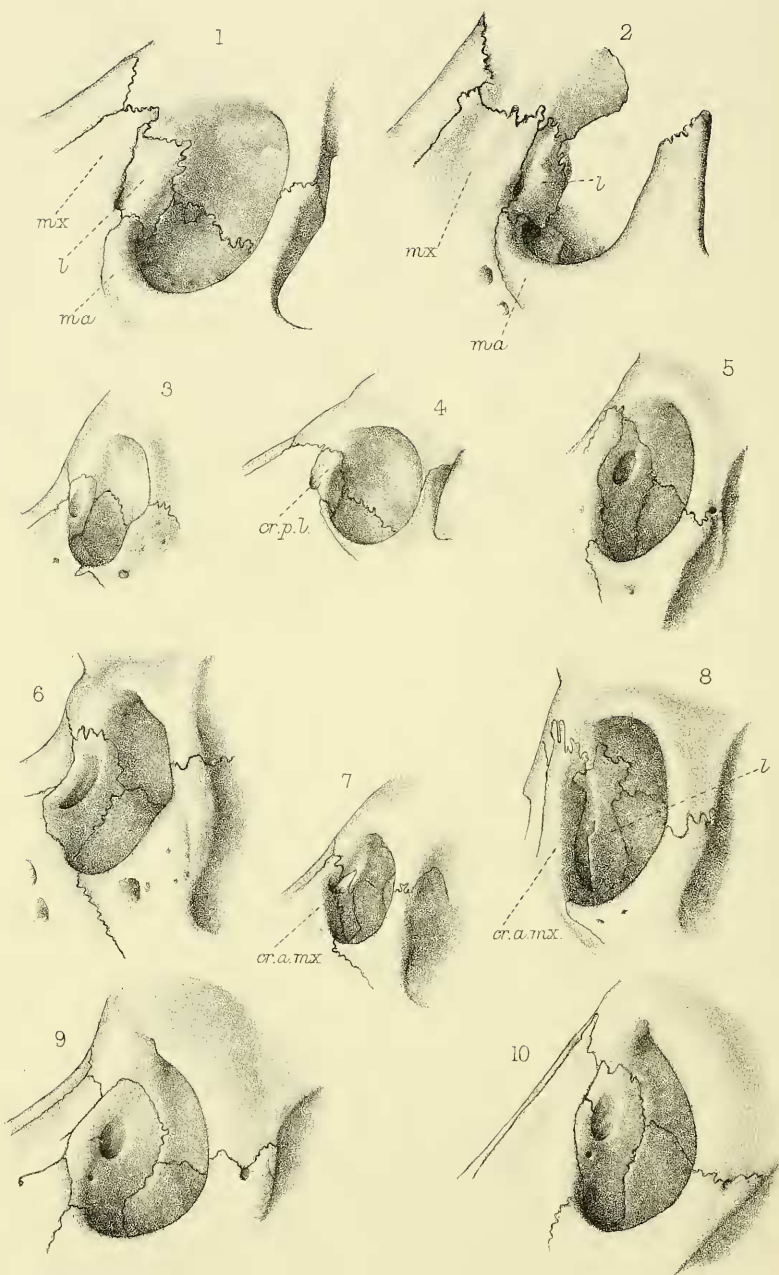
A. From above. B. Lateral view.

S (in both figures), Sylvian fissure.

(From P. Z. S. 1891, p. 457.)

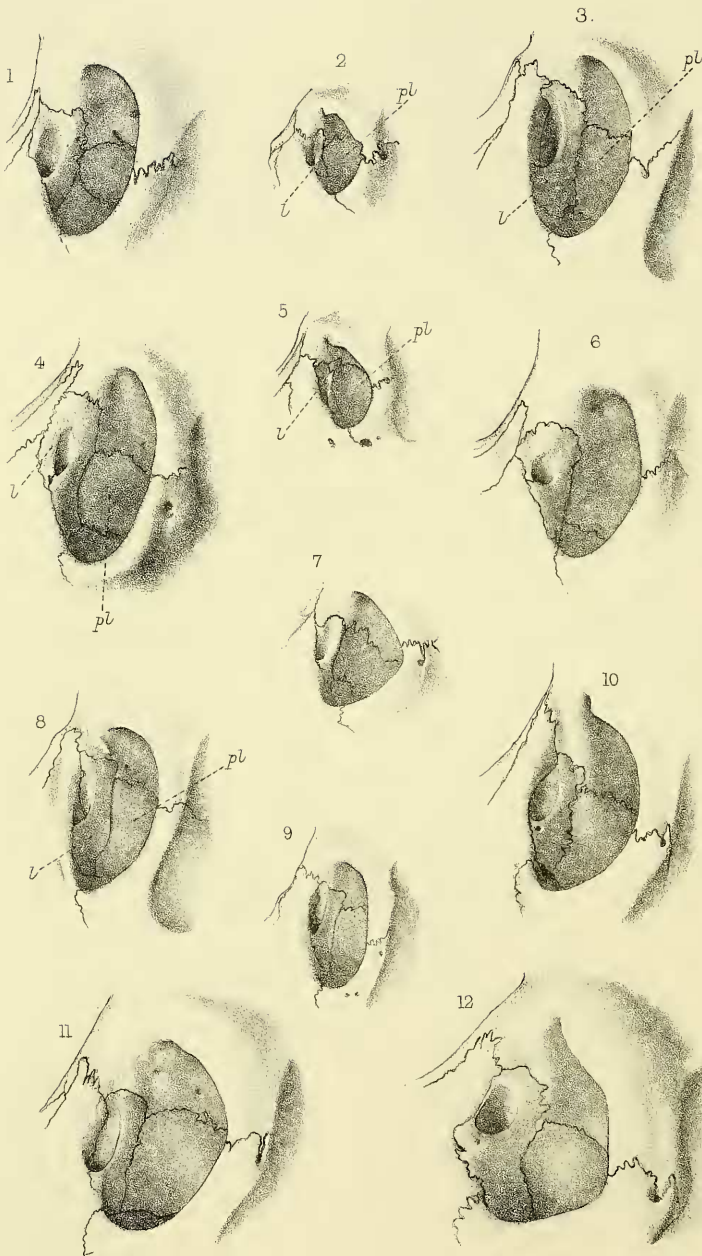
The antero-temporal fissure also differs slightly in its form. In *H. griseus* this fissure is sometimes broken into two, the upper piece joining the top of the Sylvian, as I have figured. In *H. simus* the fissure is not thus broken, but the upper end, which corresponds to the detached piece in *H. griseus*, curved forward in a hook-like fashion and in a direction parallel to the end of the Sylvian fissure.

In originally describing the brain of *H. griseus* I laid some emphasis upon the fact that the angular and the infero-frontal fissures form one continuous fissure. This emphasis is justified to some extent, since in other Lemurs the two fissures are quite distinct. But in the genus *Lemur*, which comes of course very close to *Hapalemur*, some species show a continuity and others a discontinuity between these two fissures. So, too, does this genus *Hapalemur*. In *H. simus*, as the drawing shows, the two fissures are not only discontinuous, but the two ends—the anterior of one and the posterior of the other—if continued in a straight line would hardly meet. This is quite different from what is found in *H. griseus*: in the first specimen of the brain of this animal which I studied, the two fissures were continuous at least on the left side, there being a faint gap on the right side of the brain; but in a second example of this species



G.M. Woodward lith.

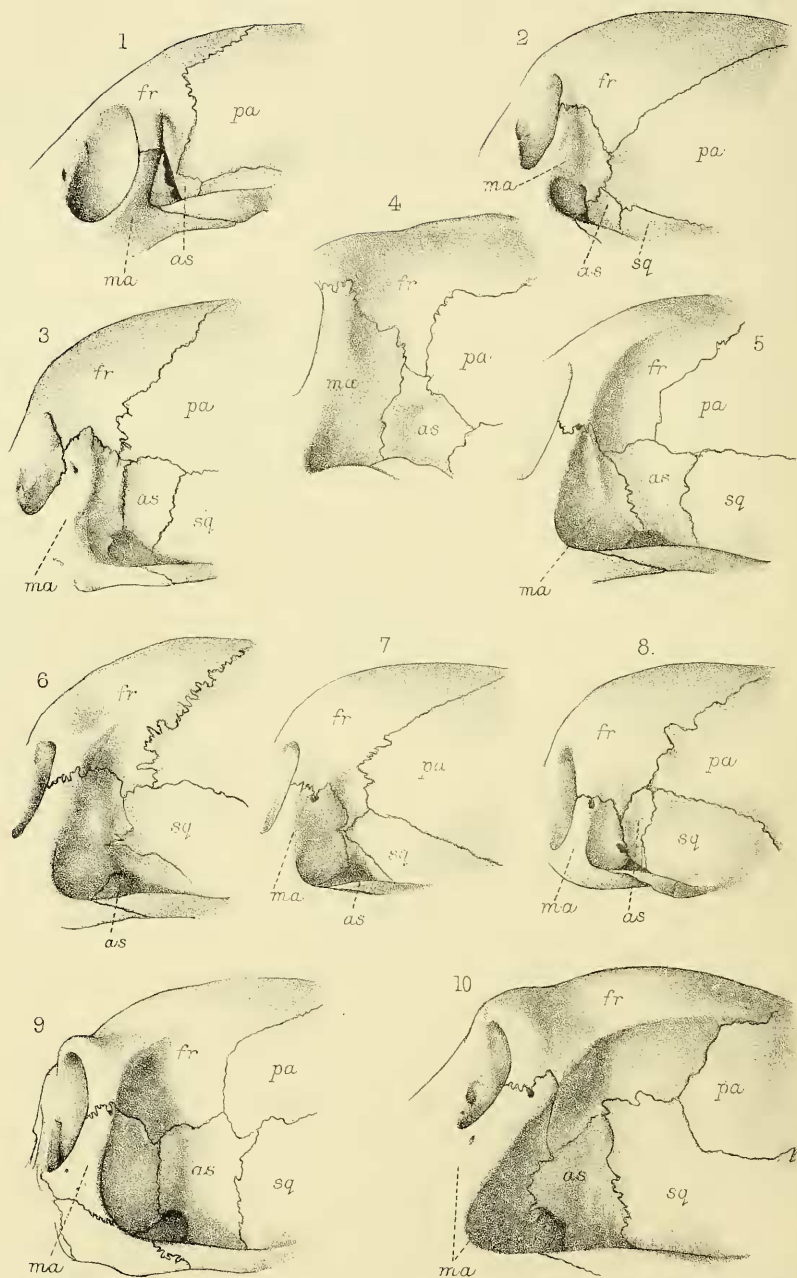
West, Newman imp



G.M.Woodward lith.

West, Newman imp.

LACRYMAL REGION OF MONKEYS.



G.M. Woodward del.

West, Newman imp.

which is before me, a distinct break separates the angular from the infero-frontal fissure. This break, however, is not so thorough that a faint groove cannot be detected bridging the chasm, and the posterior end of the infero-frontal fissure is exactly in the same line with the anterior end of the angular; if produced they would plainly meet. In the shape of the angular sulcus there are differences in the two species. In *H. griseus* this fissure is much like an elongated **S**. In *H. sinuatus* the fissure is bracket-shaped, the concavity being turned towards the inter-cerebral fissure.

6. On some Characters of the Skull in the Lemurs and Monkeys. By C. I. FORSYTH MAJOR, F.Z.S.

[Received February 5, 1901.]

(Plates XI.-XIII.¹)

(Text-figures 26-46.)

I. The Os PLANUM.

The *os planum*, or *lamina papyracea* of Human anatomy, is that part of the ethmoid which appears in the orbit, partaking in the formation of its inner wall. The presence of this bone is almost considered to be a prerogative of Man and Monkeys. Meckel denied it even to the latter; speaking of the ethmoid in Mammalia, he says:—"... dass es weit stärker entwickelt als bei den übrigen Wirbelthieren, aber sehr allgemein von den übrigen Knochen des Schädels verborgen wird, indem sich das Stirnbein durch den weit längeren, senkrechten Abschnitt seines Augenhöhlentheiles zu Bildung der inneren Augenhöhlenwand über dasselbe weglegt und von oben an den obern Rand der grossen und kleinen Keilbeinflügel stösst. Daher fehlt auch sehr allgemein den Säugthieren, selbst noch den *Affen*, das äussere Seitenblatt des Riechbeins, welches sich beim *Menschen* an der Stelle des nach oben gerückten und horizontal gewandten Augenhöhlentheiles zur Vervollständigung der innern Augenhöhlenwand bildet...."² Dursy, as late as 1869, holds the same view³.

The presence of an *os planum* in Monkeys was well known to Cuvier. With regard to the Lemurs he has the following:—"La lame criblée de l'ethmoïde dans tous les *makis*, dans les *loris* et les *galagos*, vient toucher, comme dans l'homme, au sphénoïde antérieur, tandis que dans les singes elle en reste éloignée en arrière par le rapprochement des deux côtés du frontal. L'ethmoïde tout entier est enveloppé par le frontal et par le palatin, en sorte qu'il n'en paraît rien dans l'orbite, ou, en

¹ For an explanation of the Plates, see p. 152.

² J. F. Meckel, System. d. vergl. Anat. ii. 2, pp. 516, 517 (1825).

³ E. Dursy, Zur Entwicklungsgesch. des Kopfes des Menschen und der höheren Wirbelthiere, p. 198 (1869).

d'autres termes, qu'il n'y a pas d'os planum, ce qui continue dans les carnassiers et les autres mammifères, [à un très petit nombre d'exceptions près; mais il existe encore dans les autres lémuriens]"¹.

The addition in brackets is from the pen of F. Cuvier, one of the editors of the second edition of the 'Leçons'².

Köstlin refers to the planum of Lemurs in the following sentence:—"Der Uebergang zu den Halbaffen geschieht (daher) . . . viel deutlicher von den Affen der alten, als von denen der neuen Welt, und es gehört hieher vor allen *Stenops*, bei welchem das Os planum in einem länglichen Ausschnitt des Stirnbeins liegt, und nur am untern Rande von diesem frei ist; ein ähnliches, niedres Os planum scheint *Galago* zu besitzen; dagegen fehlt es entschieden bei *Lemur*, *Lichanotus*, *Cheiromys* und wohl auch bei *Tarsius*"³.

Schröder van der Kolk and Vrolik, referring to *Nycticebus tardigradus* and *N. javanicus*, repeat almost textually Cuvier's words:—"L'ethmoïde tout entier est enveloppé par le frontal et par le palatin, en sorte qu'il n'en paraît rien dans l'orbite où, par conséquent, il n'y a pas d'os planum"⁴.

Flower says of the os planum of Monkeys:—"The os planum of the ethmoturbinals always forms part of the inner wall of the orbit, having the same relations as in Man"⁵. And with regard to the Lemurs:—"In the Common Lemur . . . the os planum of the ethmoturbinal does not enter into the inner wall of the orbit, but is shut out from it by the maxilla, as in most inferior Mammals Some of the *Lemurina* have much shorter faces than the common species, though still possessing all the essential characters of the group"⁶.

We therefore see that the writers generally deny the presence of an os planum to the Lemurs, of which the genus *Lemur* is considered to be the prototype, and it has been taken for granted that the conditions found in this genus are those of the whole group. Köstlin is the only writer who gives some positive and on the whole fairly correct information on this point.

As a matter of fact, all the species of non-Malagasy genera, viz., *Tarsius* (text-fig. 35, p. 138), *Nycticebus* (text-fig. 41, p. 140), *Loris* (text-figs. 40, 42, p. 140), *Perodicticus* (text-figs. 31-33,

¹ G. Cuvier, *Leçons d'Anat. Comp.* 2^e éd. t. ii. p. 319 (1837).

² It is difficult to understand what is meant here by "les autres lémuriens." *Tarsius* is out of the question, it being expressly stated that in the only specimen available all the sutures were obliterated. By "les loris" both *Nycticebus* and *Loris* are designated. *Chiromys* is placed among the Rodents. The only other Lemurs mentioned in the work are the "Indri" and *Avahis*, in both of which the os planum is united with the palatal at a very early date.

³ O. Köstlin, 'Der Bau des knöchernen Kopfes in den vier Klassen der Wirbelthiere,' p. 93 (1844).

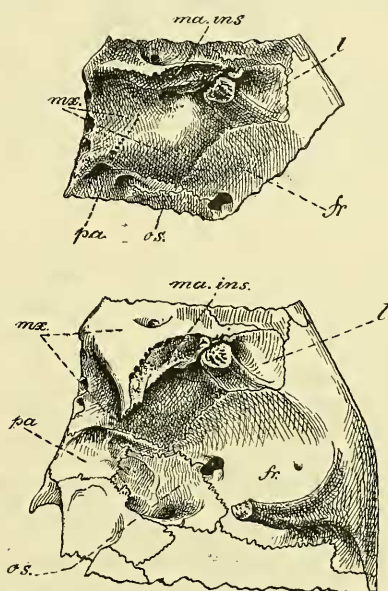
⁴ T. L. C. Schroeder van der Kolk et W. Vrolik, "Recherches d'Anatomie comparée sur le genre *Stenops* d'Illiger," in *Bijdragen tot de Dierkunde*, uitgegeven door het Genootschap Natura Artis Magistra, i. 2, p. 39 (1851).

⁵ W. H. Flower, 'An Introduction to the Osteology of the Mammalia,' 3rd ed. p. 161 (1885).

⁶ *Op. cit.* p. 166.

p. 136), *Galago* (text-figs. 34, 36, 38, 39, pp. 138, 139), possess a large os planum, which very often is not even limited to the orbit; it seems to have been overlooked because in older individuals the sutures within the orbit disappear, as indeed is the case with almost all the cranial sutures. Amongst the Malagasy Lemurs a fairly large os planum is present in all the species of *Microcebus*. In the other genera the planum becomes fused with the palatal at a very early date (text-figs. 28 & 37). A distinct small os planum is often visible in young specimens of *Haplolemur*, *Chirogale*, *Lepidolemur*, and *Avahis* (text-fig. 27), and sometimes in *Lemur*. *Chiromys* is the only Lemur in which I have not been able to trace the planum (text-fig. 26).

Text-fig. 26.

Orbital region of *Chiromys madagascariensis*. Nat. size.

ma.ins.=insertion of the malar on the maxillary; *ma.*=malar; *mx.*=maxilla;
l.=lacrymal; *pl.*=planum; *as.*=alisphenoid; *os.*=orbito-sphenoid;
fr.=frontal; *pa.*=palatal; *x.*=intercalar bone; *s.*=intercalar bone.

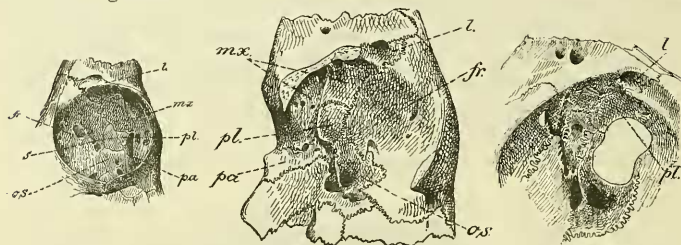
In a general manner we can state that in those Lemuridæ which are provided with a large lacrymal, the os planum is reduced; *vice versa* the lacrymal is reduced or absent—at least from the orbit and the outer surface of the cranium—in those Lemurs which are provided with a large os planum. Further particulars with regard to this bone will therefore more suitably find their place in connection with the description of the lacrymal. Sketches of the os planum in various Lemurids are given in the text-

figures. Of Monkeys I have only added those of *Callithrix* (text-fig. 46, p. 142) and *Chrysotrux* (text-fig. 29, below). It has been stated that the bone is missing in the latter genus¹; as may be seen from the figure, it is a large bone, and as such has been mentioned already by Köstlin².

Text-fig. 27.

Text-fig. 28.

Text-fig. 29.



Text-fig. 27. Orbital region of *Arachis laniger*, young, nat. size.

Text-fig. 28. The same of *Propithecus coquereli* (Br. M. No. 91.1.22.1), about $\frac{3}{4}$ nat. size.

Text-fig. 29. The same of *Chrysotrux sciureus* (Br. M. No. 932 c), about nat. size.
(Lettering as in text-fig. 26.)

II. THE LACRYMAL BONE.

As one of the distinguishing features between Lemurs and Monkeys is considered the position of the lacrymal fossa, viz., on the facial part of the skull in Lemurs, inside the orbit in Monkeys and Man.

The only writer, to my knowledge, who has considered this condition more closely is Gegenbaur³; a summary of his views is given in the following.

In lower Mammals the lacrymal is one of the facial bones; in the Sauropsidæ particularly it is for the larger part situated on the surface of the skull. In Lemurs it has preserved this position in such a manner that not even the *canalis lacrymalis* begins within the orbit. The same remark applies to Insectivora and Chiroptera. In Monkeys, the bone has been stated by older anatomists (Köstlin, Stannius) to occupy the same position as in Man, having retreated within the orbit. Gegenbaur, however, points out that considerable variations occur amongst Monkeys. Of Platyrrhinæ, three genera are taken in consideration: *Ateles*, *Myectes*, and *Nyctipithecus*. In the former two "the lacrymal

¹ "Chez les Saïmiris, qui, seuls dans tout l'ordre des Primates, n'ont pas d'*os planum*, la place ne reste vide que par suite d'un défaut d'ossification." Alfr. Grandidier, Hist. phys., naturelle et politique de Madagascar; vol. vi. Hist. Nat. des Mammifères, par MM. Alph. Milne-Edwards et Alfr. Grandidier, Tome I.—Texte i. p. 16, footnote (1875).

² *Op. cit.* pp. 92, 93.

³ C. Gegenbaur, "Ueber die Pars facialis des Lacrymale des Menschen," Morph. Jahrb. vii. pp. 173–176 (1882).

fossa is not yet situated within the orbit." In *Ateles* the lacrymal forms the greater part of the border of the fossa—including the upper half of the *crista anterior* and its antero-superior angle—and projects towards the nasal, so that there is only a narrow suture between the frontal and the frontal process of the maxillary.

In *Myetes* the lacrymal projects farther still, uniting with the nasal; besides, the whole of the fossa is encircled by the very large lacrymal, "a position which most approaches to that of Lemurs."

In *Nyctipithecus* (*N. trivirgatus*), the third platyrrhine genus mentioned, the whole of the *crista anterior* is formed by the maxilla, thus presenting a condition more closely approaching the Simiidae and Man than even in the Cercopithecidae. *Nyctipithecus* recalls *Myetes* and *Ateles* only in the projecting of the antero-superior lacrymal portion, which separates almost completely the maxillary from the frontal.

In the Cercopithecidae ("*Semnopithecus*, *Inuus*, *Cercopithecus*, *Cercocebus*, *Cynocephalus*"), although the position of the lacrymal fossa is undoubtedly orbital, it is almost entirely encircled by the lacrymal bone, the *crista anterior* being either entirely formed by the latter bone, or by the lacrymal together with the frontal process of the maxillary. All the Cercopithecidae exhibit an enlargement of that part of the lacrymal (the *hamulus* of Human anatomy) which borders the fossa laterally, so that we find here an extensive plane. Various individual variations are mentioned, to which will be referred further on. Gegenbaur sums up in the following words:—"Das von Befunden an Thieren Angeführte genügt, um zu zeigen, dass dem Lacrymale in niederen Zuständen eine faciale Ausdehnung zukommt, und dass die Pars facialis in den höheren Abtheilungen Rückbildungen erleidet, wodurch die Pars orbitalis zur ausschliesslichen Repräsentanz gelangt. In dem Maasse als diese Rückbildung stattfindet und dadurch die vordere Umgrenzung des Canalis lacrymalis vom Thränenbein aufgegeben wird, tritt der Stirnfortsatz des Oberkiefers dafür ein, und gelangt vorn zur Umschliessung jener Grube. Das ist beim Menschen wie bei anthropoiden Affen zur Regel geworden: der Hamulus ist der Rest der Verbindungsstrecke von Pars orbitalis und P. facialis . . ." ¹.

It is necessary to insist upon two results of this investigation: (1) the curious circumstance that, whilst of the three platyrrhine genera mentioned, two represent the lowest stage in Monkeys, the third one on the contrary represents the highest, if we except the Simiidae. And (2) that the encircling of the whole of the lacrymal fossa by the largely developed facial portion of the lacrymal—occurring in the Lemurs and in *Myetes*—is considered to be the lowest condition, from which the condition in higher forms is said to be derived by a gradual reduction of the *pars facialis*, the reduction being initiated by the maxillary replacing the lacrymal in front of the fossa.

¹ *Op. cit.* p. 176.

Before proceeding to a review, one by one, of the genera of Primates, a few general remarks on the lacrymal region will be necessary.

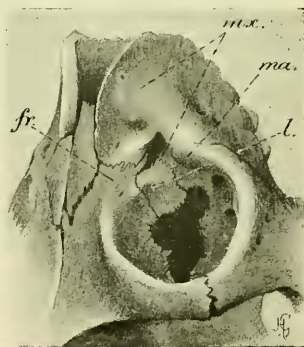
The *crista lacrymalis posterior* of Human anatomy is the vertical crest dividing the lacrymal into an anterior portion, the *sulcus lacrymalis*, and a posterior. The *crista lacrymalis anterior* is that part of the frontal process of the maxillary which in Man forms medially the lower orbital margin, in front of the *sulcus lacrymalis*. We can best describe the two fundamental types which interest us here, by stating that in Lemurs, as a rule, the *crista lacrymalis posterior* rides on the lower orbital margin, of which therefore it forms a portion (Pl. XI. fig. 4, text-figs. 27, 28, 31, 37); the anterior part of the lacrymal thus becoming the *pars facialis*, the posterior part the *pars orbitalis*. In Man and Simiidae it is the *crista lacrymalis anterior* which rides on the lower orbital margin, descending posteriorly into the orbit, where it forms the anterior part of the *sulcus l.*, and, jointly with the *hamulus lacrymalis*, delimits the lacrymal fossa. As a result, we have the lacrymal fossa outside the orbit in the first type, inside the orbit in the second (Pl. XI. figs. 7 & 8).

PROSIMLE.

Adapis parisiensis.

The only Tertiary Lemur of which the lacrymal fossa is known to me is *Adapis parisiensis*. Two skulls from the French Phosphorites, in the Geological Department, show this region well

Text-fig. 30.



Orbital region of *Adapis parisiensis* (Br. M. Geol. Dep. No. M 1345), about $\frac{2}{3}$ nat. size.

(Lettering as in text-fig. 26.)

preserved, especially the younger one (text-fig. 30), which exhibits beautifully all the sutures.

The posterior portion of the lacrymal descends to a considerable extent into the orbit, forming a very open angle with the anterior portion—the homologue of the *sulcus lacrymalis*—which runs forward almost horizontally. *But there is no crest (crista posterior l.) dividing the two portions*; and the blunt *crista anterior* is exclusively formed by the maxilla, which delimits the lacrymal fossa in front, and at the same time forms the lower anterior margin of the orbit. The lacrymal fossa, therefore, is situated entirely inside the orbit. The malar bone, which laterally continues the lower orbital margin, proceeds farther medially than in Man and generally in Monkeys, without, however, reaching the lacrymal, from which it is separated by a process of the maxillary projecting laterally into the fossa. Medially, a similar process of the frontal enters also the fossa from behind, the lacrymal (the anterior part of which is broken in the specimen) being thus situated between the two processes.

P. Gervais, to whom we owe one of the earliest descriptions of the skull of *Adapis parisiensis* ("*Palaeolemur*")¹, mentions as one of the Lemurine features of the skull "*la position inféro-externe du tron lacrymal et son développement.*" In his figure 3 (pl. xvii.) are in fact represented two foramina situated on the facial part of the cranium and occupying approximately the position of the *fossa lacrymalis* in many recent Lemurs. The comparison of Gervais's figure with the skull in the British Museum (No. M 1345) shows, however, that these supposed lacrymal foramina are not foramina at all, but deep circumscribed depressions of the maxillary, in front of *crista anterior*, which exhibit the appearance of foramina when the shade falls into the hollow. In a subsequent publication by Gervais², either the author or the artist seems to have become aware of this fact, for the two supposed foramina are entirely omitted from the figure representing the very same cranium; the description is, however, reprinted³ without alteration from the 'Journal.'

The skulls of *Adapis magnus* in the Geological Department show the cranial region which interests us here, in a broken condition, and in the same case are unfortunately the skulls of *Microcherus* (*Necrolemur*). For the present, therefore, the oldest Lemurid exhibiting the lacrymal region shows it to be conformed exactly the inverse of what might have been anticipated and in fact has been supposed to be the case.

Since *Adapis parisiensis* agrees in several important features with recent, and most of all with the Malagasy, Lemurs⁴, it may be fairly taken to be in their ancestral line. The condition of the lacrymal region in recent Lemuridæ is easily derivable from that obtaining in *A. parisiensis*, in supposing that by the flattening of the maxilla's *crista anterior* and the upraising of a *crista*

¹ Journ. de Zool. ii. p. 422, pl. xvii. (1873).

² Zool. et Pal. gén. ii. pl. viii. fig. 2 a (1876).

³ *Op. cit.* p. 32.

⁴ P. Z. S. 1899, p. 988.

posterior, the lacrymal fossa comes to be extra-orbital. Recent Lemuridæ show a considerable amount of variation in this respect, and we have therefore to examine them somewhat in detail.

Perodicticus.

Here we meet with a *crista posterior*, separating a *pars facialis* and a *pars orbitalis*; the whole of the former's fossa is bordered by the maxilla. In none of the species does the malar reach the lacrymal.

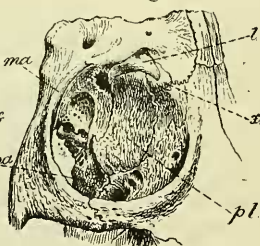
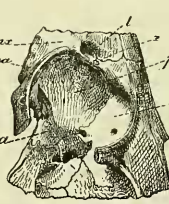
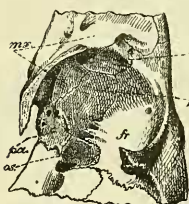
In the specimen which is the type of Bennett's "*P. geoffroyi*" (Br. M. Z. D. No. 55.12.26.230) (see text-fig. 33), the *pars facialis* has a very limited extent; the *pars orbitalis* starts from the crista posterior in a lateral and downward direction, till it reaches an unossified opening, a sort of irregularly-shaped fontanelle; in front it unites by a suture with the maxillary, behind with the os planum. On the medial side of the crista posterior, situated between the lacrymal, frontal and maxilla, is an intercalary bone (*x*).

In the *P. potto* (Br. M. Z. D. Nos. 56.11.10.5 and 46.12.5.1) (text-fig. 31) the orbital portion of the lacrymal is of moderate size, and delimited posteriorly—proceeding from the medial towards the lateral side—by the frontal, os planum, maxillary, lacuna, maxillary. On the orbital margin the lacrymal is raised to a crista posterior, and unites with the frontal and maxillary, which form the medial and lateral continuation, respectively, of the crista posterior. The lateral and anterior margins of the facial fossa *l.* are formed by the maxillary. In older specimens of the Potto the sutures are obliterated.

Text-fig. 31.

Text-fig. 32.

Text-fig. 33.



Text-fig. 31. Orbital region of *Perodicticus potto* (Br. M. No. 46.12.5.1), about nat. size.

Text-fig. 32. The same of *Perodicticus calabarensis* (Br. M. No. 46.11.10.5), about nat. size.

Text-fig. 33. The same of the type of "*Perodicticus geoffroyi* Benn." (Br. M. No. 55.12.26.230), about $\frac{2}{3}$ nat. size.

(Lettering as in text-fig. 26.)

In *Perodicticus calabarensis* (Br. M. Z. D. No. 0.11.30.1; ♀) the orbital part of the lacrymal is very narrow (transversely), and so is the *pars facialis*, which is, however, more elongate than in

P. geoffroyi. The extra-orbital fossa is encircled entirely by the maxilla. A small intercalary bone (*x*), in the same position as the one mentioned in *P. geoffroyi*, is on its way to become soldered to the frontal.

A second specimen of *P. calabarensis* (Br. M. Z. D. No. 46.11. 10.5) is slightly older than the preceding. There is scarcely any pars orbitalis worth speaking of, the os planum reaching almost the crista posterior. On the right side it is almost completely joined to the lacrymal by synostosis, the suture being preserved only in the medial moiety; on the left side (text-fig. 32) a process of the maxillary—bounded in front by the lacrymal, behind by the os planum—forms more than half of the crista posterior (laterally); the medial extremity of this latter is formed by the frontal. So that the lacrymal contributes only in a slight measure to the formation of the crista posterior; it is, however, more developed on the right side. The pars facialis of the lacrymal and its fossa proceed diagonally in an antero-external direction, and are delimited by the maxillary, which in front and laterally forms a real crista anterior, the latter being flattened medially, as is the case also in the former specimen.

Tarsius.

The *crista post. l.* is formed by the lacrymal. The *pars orbitalis l.* is much reduced in size; the *pars facialis l.*, bearing the fossa, is for the greater part, in front, entirely encircled by the maxilla. A fronto-maxillary suture. The malar remains far behind on the orbital margin, its anterior end being above the anterior termination of *m. 2*.

Tarsius spectrum (Br. M. Z. D. No. 90.7.25.1). Teeth moderately worn.—Inside the orbit the os planum closely approaches the *crista post.*, so that there is scarcely any *pars orbit. lacr.* Laterally from the os planum occurs a fontanelle. Outside the orbit, the maxillary, besides encircling the fossa, advances into the latter on its lateral side.

Tarsius philippinensis, ♂ (Br. M. No. 97.3.1.1). Young specimen with deciduous dentition in place (text-fig. 35).—Similar to the preceding species, but the lateral part of the *pars orbitalis lacr.* has a larger extension.

Tarsius, therefore, on the whole closely resembles the other non-Malagasy Lemurs in the conformation of the lacrymal region.

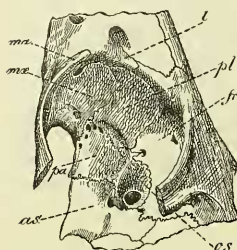
Galago.

The lacrymal is more reduced in size than in any of the Malagasy Lemuridæ. The anterior boundary of the *fossa lacrymalis*, situated on the cheek, is always provided by the maxilla, which forms the roof of the canalis *l.*, and may also protrude more or less into the fossa.

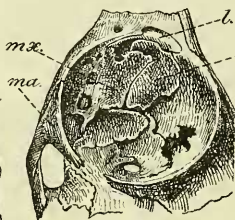
The malar may or may not reach the lacrymal. There never occurs a lacrymo-nasal suture.

In the group of large-sized *Galagos* (subgen. *Otolemur*) (text-fig. 34) the lacrymal is not only absolutely larger than in the other subgenera, but also comparatively so. Within the orbit the lacrymal is delimited laterally by the maxilla, medially by the os planum. The maxilla, besides bordering the *fossa lacrymalis* and forming the anterior roof of the *canalis l.*, penetrates also into the fossa, the bottom of which it forms jointly with the lacrymal. In young specimens the malar joins the lacrymal.

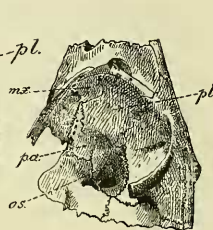
Text-fig. 34.



Text-fig. 35.



Text-fig. 36.



Text-fig. 34. Orbital region of *Galago* (*Otolemur*) *crassicaudatus* (Br. M. No. 92.10.18.10), about nat. size.

Text-fig. 35. The same of *Tarsius philippinensis* (Br. M. No. 97.3.1.1), about $\frac{3}{2}$ nat. size.

Text-fig. 36. The same of *Galago* (*Otolienus*) *alleni* (Br. M. No. 99.4.6.5), about nat. size.

(Lettering as in text-fig. 26.)

Galago (*Otolienus*) *senegalensis* (four specimens).—In some individuals the *pars orbitalis l.* is extremely reduced, the maxillary (laterally) and the os planum (medially) almost reaching the *crista posterior*. The whole of the boundary of the fossa and part of its bottom is provided by the maxilla. In three young specimens the malar is separated from the lacrymal by a very thin process of the maxilla; in the fourth, an aged specimen, the bones are more widely separated.

Galago (*Otolienus*) *alleni* (four specimens) (text-fig. 36).—The *portio orbitalis* is slightly larger than in the preceding species. The whole of the fossa is encircled by the maxilla, which also enters the fossa, with the result that its bottom is only to a limited extent occupied by the lacrymal; in one instance the latter does not even reach the aperture of the *canalis l.* In one of the four specimens the malar is in contact with the lacrymal; in a second, young specimen, a strong lens is required to perceive the thin strip of maxillary dividing the two bones.

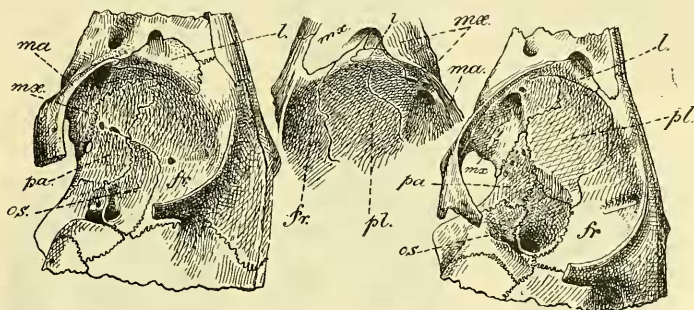
Galago (*Otolienus*) *elegantulus* (four specimens).—In two of the skulls the lacrymal sutures are mostly obliterated, although the teeth are only moderately worn. In the two remaining specimens (Br. M. No. 1410 a & b) the lacrymal is either so much reduced in size, or so much covered by the adjoining bones, that

it presents itself merely as a minute oblong splint of bone situated in the fossa, chiefly in front of the orbital margin, which it reaches almost or entirely. In front of this rudimentary lacrymal the whole of the bottom of the fossa and its raised anterior margin pertain to the maxilla. Behind it, the frontal and maxilla join on the orbital margin, thus forming the *crista posterior* and separating the lacrymal from the os planum, which latter also almost reaches the orbital margin from inside the orbit. There is therefore no trace of a *pars orbitalis lacrymalis*. Neither is there a lacrymo-malar suture, the latter bone being removed farther backward than in any of the preceding species.

Text-fig. 37.

Text-fig. 38.

Text-fig. 39.



Text-fig. 37. Orbital region of *Opolemur thomasi* (Br. M. No. 91.11.30.50), about $\frac{2}{3}$ nat. size.

Text-fig. 38. The same of *Galago (Hemigalago) demidoffi* (Br. M. No. 97.12.1.5), about $\frac{2}{3}$ nat. size.

Text-fig. 39. The same of *Galago (Hemigalago) demidoffi* (Br. M. No. 98.5.4.3), about $\frac{2}{3}$ nat. size.

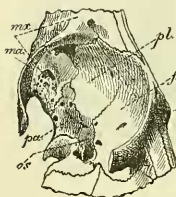
(Lettering as in text-fig. 26.)

Galago (Hemigalago) demidoffi (six specimens).—Here we find a moderately-sized *pars orbitalis lacrymalis*, and in most of the specimens the *crista posterior* is formed by the lacrymal alone (text-fig. 39). In one individual (Br. M. No. 97.12.1.4) the os planum encroaches on the orbital margin, between the lacrymal (laterally) and the frontal (medially), thus partaking to a slight extent in the formation of the *crista posterior*. On the right side it protrudes even on the facial part, by means of a slight process, which in the fossa is situated between the maxillary (medially) and the lacrymal (laterally). In another specimen (Br. M. No. 97.12.1.5) the conditions are very similar, the os planum of both sides protruding into the fossa, on the right side as far as the entrance of the canalis (text-fig. 38). In the younger specimens (Br. M. No. 811a and No. 98.5.4.3) the malar reaches the lacrymal inside the orbit.

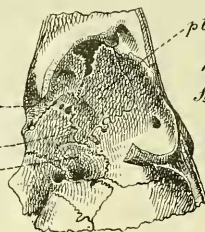
Loris.

Five specimens examined.—The lacrymal appears neither inside the orbit nor on the face. In front of the orbit there is a "fossa," entirely encircled by the maxilla. The *crista posterior* is also formed chiefly, in one case (Br. M. No. 67 *c*, left side) entirely, by two processes of the maxilla, which in the latter instance unite on the orbital margin, above the os planum, and are always continued forwards into the fossa. In most specimens these two processes are separated on the orbital margin by a minute process of the planum, which therefore partakes in the formation of the *crista posterior*. In the anterior part of the fossa—where the latter, being roofed over by the maxilla, has become the canalis—may be seen a thin bone which is either the free termination of the reduced lacrymal, covered by the maxillary in the anterior part of the fossa, or, may be, the termination of the os

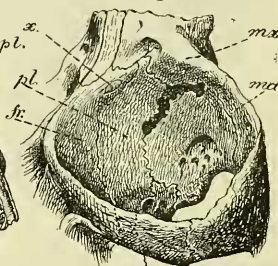
Text-fig. 40.



Text-fig. 41.



Text-fig. 42.



Text-fig. 40. Orbital region of *Loris gracilis* (Br. M. No. 48.10.31.3), about nat. size.

Text-fig. 41. The same of *Nycticebus tardigradus* (Br. M. No. 96.11.29.4), about nat. size.

Text-fig. 42. The same of *Loris gracilis* (R. Coll. Surg. Lond. No. 290), about $\frac{2}{3}$ nat. size.

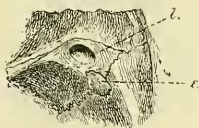
(Lettering as in text-fig. 26.)

planum. In one specimen (Br. M. No. 67 *d*) the process of the planum can be traced from the crista posterior forward to the anterior end of the canalis; in the absence of very young specimens it cannot be decided whether this anterior portion is the much reduced lacrymal united by synostosis with the planum, or the planum itself. In a specimen from the collection of the Royal College of Surgeons (No. 290), the condition displayed on the right side conveys the impression that the thin bony plate, visible in the canalis beneath the maxillary roof, is in fact the lacrymal. On both sides of the skull the planum creeps up on the orbital margin and separates the frontal from the maxillary, the former bone in this specimen partaking medially in the formation of the margin. In front of the os planum, a lateral and a medial process of the maxillary unite

within the fossa, and separate again almost immediately, so as to include between each other the thin bony plate above mentioned.

In several of the younger specimens an intercalar bone is present as in *Perodicticus*. In specimen No. 67 *d* (Br. M.) it forms the medial continuation of the crista posterior, being limited anteriorly by the maxilla—with which it begins to co-ossify,—medially by the nasal, laterally by the planum, posteriorly by the frontal. In other slightly older specimens (Br. M. No. 67 *a*, No. 67 *c*; R. C. S. No. 290) the intercalar bone is almost completely overgrown by the frontal.

Text-fig. 43.



Lacrymal region of *Avahis laniger*, about $\frac{1}{3}$ nat. size.

(Lettering as in text-fig. 26.)

The malar terminates anteriorly above the interspace between m. 1 and the posterior premolar.

Nycticebus.

In this genus (see text-fig. 41) the crista posterior appears to be formed, either by the maxillary (laterally) and the frontal (medially)—joining in a suture in advance of, and above, the os planum,—or by two processes of the maxillary, joining in the same manner. Younger specimens show an intercalar bone which occupies the same position as in *Perodicticus* and *Loris*, and coalesces either with the maxillary or with the frontal. In some cases (*N. javanicus*, Br. M. No. 66 *e*; *N. tardigradus*, Br. M. No. 1550 *b*) a small process of the planum creeps upon the orbital margin between the maxilla and the frontal, or even advances into the fossa.

There is no trace of the lacrymal within the orbit, nor, as has just been stated, on the orbital margin, where it seems to have been entirely covered by the maxilla, os planum, and frontal. Neither can the lacrymal be traced in the groove which in front of the *crista posterior* represents the *fossa lacrymalis* of other Lemurs. With the exceptions before mentioned, when the planum encroaches on the fossa, the bottom of the latter is made up by two processes of the maxilla, which also encircles the *canalis l.* in front.

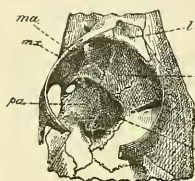
The malar does not advance on the orbital margin farther than above the posterior end or the middle of the posterior premolar.

In old specimens all the sutures are obliterated.

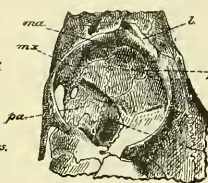
Microcebus.

Three species have been examined, viz., *M. smithi*, *M. minor*, and *M. coquereli*—The fossa lacrymalis is on the facial portion; in all the species its anterior border is formed by the maxillary (text-figs. 44 & 45). The lower orbital margin is formed by the *crista posterior* of the lacrymal, with which the malar bone laterally articulates.

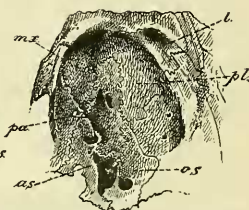
Text-fig. 44.



Text-fig. 45.



Text-fig. 46.



Text-fig. 44. Orbital region of *Microcebus smithi* (Br. M. No. 37.9.26.78), about $\frac{1}{2}$ nat. size.

Text-fig. 45. The same of *Microcebus smithi* (Br. M. No. 35.12.26.281), about $\frac{1}{2}$ nat. size.

Text-fig. 46. The same of *Callithrix personata* (Br. M. No. 45.4.2.11), about nat. size.

(Lettering as in text-fig. 26.)

M. smithi.—Out of twelve specimens examined, in six the lacrymal expands medially on the face, so as to reach the nasal, and form a sometimes rather elongate lacrymo-nasal suture (text-figs. 44 & 45). In the other six cases the frontal and maxillary separate the two bones mentioned before, so that we have a fronto-maxillary suture, which is always very short and in some cases nothing more than a mere touching of the two bones.

M. minor.—In the three specimens examined, a lacrymo-nasal suture is brought about by both the bones sending a process to meet one another; in one of the specimens, on one side a very thin process of the frontal joins the maxillary, so as to separate the nasal from the lacrymal.

Opolemur (text-fig. 37).

The anterior margin of the facial fossa lacr. is formed by the maxillary. The lacrymal does not reach the nasal, a broad junction of the frontal and maxillary taking place between the former two bones. The malar reaches the lacrymal; the lacrymo-malar suture is inside the orbit and continued on the orbital margin. The orbital portion of the lacrymal is broad, without, however, extending far into the orbit; behind it is limited by the frontal (medially) and the maxillary (laterally), no separate os planum being present.

Chirogale.

Ch. milii (5 specimens).—The lacrymal is broad and chiefly facial. Anteriorly the fossa lacrymalis is bordered by the maxillary. There is a fronto-maxillary suture, the lacrymal not meeting the nasal. The malar joins the lacrymal on the orbital margin and within the orbit. The small orbital portion of the lacrymal is delimited behind in the same manner as in *Opolemur*. In one youngish specimen only (Br. M. Z. D. No. 88.218.3) a very small distinct os planum appears between the maxillary and frontal, articulating besides in front with the lacrymal. In aged specimens the lacrymal sutures are mostly obliterated, the lacrymal uniting with the maxillary.

"*Chirogale*" *trichotis*, Günth. (Br. M. Z. D. No. 75.1.29.2).—The facial cranium is more drawn out than in the former species, and in connection with this the lacrymal fossa has a more anterior position; as usual, it is bordered in front by the maxillary.

CEBIDÆ.

Mycetes.

Forty-one skulls have been examined.—Only in fifteen specimens the lacrymal fossa is wholly encircled by the lacrymal bone, as described and figured¹ by Gegenbaur; the anterior boundary of the fossa, which protrudes on the cheek, increases with the age of the animal, the whole of the lacrymal assuming in old individuals (Pl. XI. fig. 6) a more oblique position, in accordance with the general direction of the facial cranium. In twenty-two cases the maxilla partakes to a slight extent in the forming of the antero-inferior margin of the fossa; this is nearly always the case in very young specimens (Pl. XI. fig. 3); but it may occur also in very old individuals (e. g., *M. seniculus*, Br. M. No. 44 e). A lacrymo-nasal suture occurs almost without exception; in very young specimens the two bones may barely touch each other, without a true suture being formed. In one of the two youngest specimens available (*M. seniculus*, Leyden Mus. r; d. 1 not quite protruded), a pointed process of the maxillary reaches the frontal on the left side, on the right a minute Wormian bone is interposed. In the second specimen, which I owe to Prof. Rud. Burckhardt (the deciduous incisors and d. 3 alone in place), a comparatively elongate lacrymo-nasal suture is present on both sides.

As in the following genus, it is sometimes a matter of mere individual appreciation whether to consider the lacrymal fossa as intra- or extra-orbital; in fact in some cases it is neither inside nor outside the orbit. Of course, it depends where we draw the limits of the orbita; but when there are no definite limits, this becomes a matter of some difficulty.

¹ *Op. cit.* p. 175, fig. II A.

Ateles.

In 14 out of 25 specimens examined, the *fossa lacrymalis* was completely encircled by the lacrymal (Pl. XII. figs. 4 & 6), in six more cases the maxilla merely touched the fossa near its antero-inferior border. Only in five specimens was found a slightly more extended maxillary margin of the fossa, such as figured by Gegenbaur¹. The supero-anterior angle of the lacrymal also protrudes more on the face than suggested by the mentioned figure. A lacrymo-nasal suture was found in 12 cases (Pl. XII. figs. 4 & 6); a mixed condition, viz. a lacrymo-nasal suture on one side only, in three cases. Only in eight cases did I find a fronto-maxillary suture, which is always very limited, as described by Gegenbaur.

It cannot be said that in every case the *fossa lacrymalis* is decidedly extra-orbital; this condition is rather an exception in *Ateles*, occurring when the crista posterior is more than usually prominent. Where the orbit presents no marked limits in this region, it is, as with *Myecetes*, a matter of mere individual appreciation whether we have to regard the fossa as lying inside or outside the orbit. That there are variations in this respect in *Ateles*, was already known to G. Fischer, who says that in a skull of *A. paniscus* the aperture of the lacrymal canal was situated "auf der Grenze der Augenhöhle, oder auf seinem (sic!) Rande, aber doch immer mehr nach innen," whilst other skulls of the same species presented the same conformation as in the other species².

Brachyteles.

The skull of this rare monkey, of which I could examine only seven specimens—one in Leyden, six in the Natural History Museum—exhibits a very broad interorbital region, due in a great measure to the large development of the lacrymal. In spite of this, the anterior boundary of the fossa is for the greater part—in one case entirely—formed by the maxilla, which in two cases even protrudes into the fossa. In the upper region the lacrymal advances on the face, so that the fronto-maxillary suture is either very limited, or in two cases—*B. hypoxanthus*, Leyden; *B. arachnoides*, Br. M. No. 43.10.12.2 (Pl. XII. fig. 1)—a lacrymo-nasal suture is present.

Callithrix.

Sixteen skulls examined.—The anterior margin of the lacrymal fossa is always bordered by the maxilla, at least on its lower half (Pl. XII. fig. 7), and sometimes (*C. donacophila*) on its whole extension. The antero-superior angle of the lacrymal protrudes forwards, least of all in *C. donacophila*, which therefore exhibits a very broad fronto-maxillary suture; in all the other species there is

¹ *Op. cit.* p. 175, fig. II B.

² G. Fischer, *Anatomie der Maki*, p. 90 (1804).

also a fronto-maxillary suture, although of less extent. In *Caltilthrix* the lacrymal therefore occupies a more backward position than in the preceding genera. Notwithstanding this, the *crista post.* is generally very strong, the *crista ant.*, on the contrary, much flattened, especially in its upper region; so that in some cases—*C. nigrifrons*, Br. M. No. 51 *c*; *C. personata*, Br. M. No. 45.4.2.11 (Pl. XII. fig. 7) and No. 51 *d*—the fossa appears quite as much outside the orbit as in extreme cases of *Ateles*.

Nyctipithecus.

Fourteen skulls.—As described by Gegenbaur in *N. trivirgatus*, the whole of the *crista posterior* belongs to the maxilla, which, moreover, generally descends into the fossa. In the only skull of *N. trivirgatus* available (Br. M. No. 1459 *b*)—in a second skull of this species the sutures are obliterated—the antero-superior angle of the lacrymal advances so far forwards, that the maxillary becomes separated from the frontal, and a lacrymo-nasal suture is brought about. The same occurs in two skulls of *Nyctipithecus* sp. (Br. M. No. 97.10.3.8 and No. 92.2.18.1), in the latter of which the suture between the two bones is chiefly due to the breadth of the nasal in this place. In all other skulls—*N. felinus* (seven specimens), *N. rufipes* (one), *N. sp. inc.* (two)—the frontal and maxillary join between the lacrymal and nasal, so as to form a comparatively broad fronto-maxillary suture.

Brachyurus.

Three skulls of *B. calvus*.—The conformation of the lacrymal is on the whole similar to that of the preceding genus. The *crista anterior* of the maxilla forms the lower orbital margin and the anterior boundary of the fossa. In one skull (Br. M. No. 806 *b*) the lacrymal extends its antero-superior angle towards the nasal, which, in its turn, sends backwards a process, so that—on the left side—lacrymal and nasal join each other.

Pithecia.

Seven skulls.—Similar to the preceding genus. In two cases, viz. *P. leucocephala* (Br. M. No. 66.8.6.1) and *P. sp.* (Br. M. No. 1294 *a*), the lacrymal forms the upper margin of the fossa and at the same time joins the nasal anteriorly.

The remaining genera of Cebidæ, *Lagothrix*, *Chrysothrix*, and *Cebus*, present essentially the conditions of the Simiidæ.

Lagothrix.

Twenty-two skulls.—The lacrymal fossa is decidedly within the orbit. The whole of the *crista anterior* is formed by the maxilla, forms the orbital margin, and, moreover, descends into the fossa. In a few cases the antero-superior angle of the lacrymal advances on the facial region, but only once (*L. sp.*, Br. M. No. 0.11.5.17)

a naso-lacrymal suture occurs, which, however, is due to a backward extension of the nasals. In four skulls the lateral region of the fossa—the hamulus-region of the human lacrymal—formed by the lacrymal is considerably enlarged.

Chrysothrix.

Ch. sciureus (Pl. XI. fig. 7) and *Ch. entomophagus*; 9 skulls.—The lacrymal fossa and the whole of the lacrymal bone are completely within the orbit. The maxilla, besides forming the lower orbital margin, protrudes far below into the fossa, throwing back the lacrymal. The frontal also generally advances into the fossa, from above. It is a characteristic feature of *Chrysothrix* that the frontal descends unusually far below on the dorsum nasale and inside the orbit, so that the fronto-maxillary suture becomes very large and often extends backwards into the upper part of the *fossa lacrymalis*.

Cebus.

Forty-one skulls.—The lacrymal region is eminently “anthropomorphic” in all the species. The *crista posterior* is situated at a lower level than the *crista anterior*, which is convex forwards and exclusively formed by the maxilla; the latter not only delimits the whole anterior margin of the fossa, but descends into it and occupies besides the whole of the antero-superior region, so that there is generally a very broad fronto-maxillary suture. (An exception is presented by one skull, *C. capucinus*, Br. M. No. 1049, in which the nasal extends from its root backwards along the upper margin of the maxillary, so that we have a lacrymo-nasal suture within the fossa.) The upper part of the fossa appears continued on the frontal, the *crista posterior*, and sometimes (*C. xanthocephalus*) both the *c. ant.* and *c. post.*, being continued on that bone.

HAPALIDÆ.

The fossa lacrymalis is decidedly orbital. As a rule, the whole of the *crista anterior* is formed by the maxillary, which descends into the fossa.

Hapale.

Nineteen skulls examined.—A lacrymo-nasal suture occurs in 6 out of the 19 specimens. The os planum encroaches upon the lacrymal from behind; the *crista posterior* is formed solely by the lacrymal as a rule, but sometimes the os planum partakes in its formation. In *H. jacchus* the upper part of the *crista anterior* is rather flattened, so that the lacrymal encroaches upon the face, and the fronto-maxillary suture either becomes very shortened or is replaced by a lacrymo-nasal suture (in three specimens of this species). The os planum helps to join the *crista posterior* in one specimen of this species (Br. M. No. 1216 b). In two out of four specimens of *H. aurita* we have a lacrymo-nasal suture; besides

in one of them the upper part of the *crista anterior* is formed by the lacrymal and maxillary jointly. In one of the four specimens of the same species (Br. M. No. 56 *b*) the os planum partakes in the formation of the *crista posterior*.

Midas.

Fifteen skulls (Pl. XII. figs. 2 & 5).—On the whole similar to *Hapale*, but the supero-anterior angle of the lacrymal encroaches less upon the cheek; the fronto-maxillary suture is generally broad, sometimes it is somewhat reduced by the advance of the lacrymal; but I have not met with a lacrymo-nasal suture. The lacrymal is also otherwise reduced in size; from above, the frontal sends a process into the fossa; from behind, the os planum encroaches upon the *crista posterior* (e. g. *M. mystax*, Br. M. No. 992 *a*, *M. rufiventer*, Br. M. No. 45.4.2.8) (Pl. XII. fig. 5). In one skull of *M. chrysomelas* (= *M. flavifrons*, Br. M. No. 1528 *a*) the *crista posterior* is chiefly formed by the os planum.

CERCOPITHECIDÆ.

Semnopithecus.

With regard to this genus, my material discountenances Gegenbaur's statement, who says that, like in the rest of the family, in *Semnopithecus* almost the whole of the fossa is encircled by the lacrymal, so that the *crista anterior* is either entirely supported by this bone, or by the lacrymal in conjunction with the frontal process of the maxillary. And again: "A small portion of the maxillary forms the anterior border of the fossa in *Semnopithecus* (*S. nasicus*)"¹.

I have examined the lacrymal region of 93 skulls of *Semnopithecus*, with the result that only in four cases the conditions are similar or nearly so as described by Gegenbaur; so that I apprehend that he had no true *Semnopithecus* at his disposal. In fact the only species mentioned is "*S. nasicus*," the *Nasalis*, in which the conditions are somewhat different from those of *Semnopithecus*.

If we except *Miopithecus* and *Rhinopithecus* (Pl. XI. fig. 8), *Semnopithecus* is the most anthropoid of the Cercopithecidæ with regard to its lacrymal. Not only is the *crista anterior* supported by the maxilla alone, in 89 out of 93 specimens, but generally the latter bone penetrates also into the fossa, thus throwing back the lacrymal. In several cases the participation of the lacrymal in the formation of the fossa is further restricted by the frontal penetrating into it from above (e.g., *S. pyrrhus*, Br. M. No. 55.12.24.11, *S. obscurus*, Br. M. No. 79.11.21.298, *S. priamus*, Br. M. No. 79.9.5.4); but generally the antero-superior angle of the lacrymal advances slightly towards the face (Pl. XII. fig. 8). In four cases only (*S. entellus*, Br. M. No. 13 *j* & 13 *p*; *S. cristatus*,

¹ *Op. cit.* p. 175.

Br. M. No. 78.8.30.4 ; *S. sabanus*, Br. M. No. 93.3.4.3) the lacrymal shares with the maxillary the anterior boundary of the fossa.

Colobus (Pl. XII. fig. 3).

The lacrymal is slightly more developed in front than in *Semnopithecus*, thus more approaching the condition attributed to the latter genus by Gegenbaur.

Nasalis.

In *Nasalis* (Pl. XII. fig. 11) the antero-superior angle of the lacrymal and its lateral portion—the hamulus-region—extend forwards ; between them, the maxilla borders the fossa and sometimes even descends into it. As the *crista anterior* is, however, much flattened, a condition approaching *Ateles* is the result.

Papio.

Papio is the very reverse of *Semnopithecus*. In the 52 specimens examined, the anterior margin of the fossa is, almost without any exception, formed by the lacrymal alone (Pl. XI. figs. 9 & 10). In ten specimens the *crista anterior* is supported exclusively by the lacrymal, which in several individuals expands forwards beyond the crista ; so that, whenever the *crista ant.* is flattened—an occurrence met with in young and adult specimens (Pl. XI. fig. 9)—the fossa is as much extra-orbital as in many cases of *Mycetes* and *Ateles*.

In the majority of specimens the *crista anterior* is formed by the lacrymal in conjunction with the maxilla.

Cynopithecus.

In *Cynopithecus* the conditions nearly resemble those of the preceding genus. In the seven skulls examined, the lacrymal, however, never protrudes on the face, the *crista anterior* being always formed by both lacrymal and maxilla. In three cases the boundary of the anterior margin of the fossa is supplied exclusively by the lacrymal.

Macacus.

Seventy-nine skulls have been examined. In eight specimens the condition of the lacrymal was found to be similar to that prevailing in *Semnopithecus*, viz., the *crista anterior* formed by the maxillary alone, which generally descends also into the fossa. The eight specimens belong to *M. philippinensis* (2), *M. cynomolgus*, *M. radiatus*, *M. pileatus*, *M. rhesus*, *M. speciosus*, *M. sp.* (Br. M. No. 45.1.8.4). In six cases—*M. silenus*, *M. philippinensis*, *M. cynomolgus* (2), *M. rhesus*, *M. sp.* (Br. M. No. 69.3.5.15)—the maxillary forms the larger portion of the anterior boundary of the fossa. Conversely in one instance, an old individual of *M. nemestrinus* (Br. M. No. 28 c) (Pl. XII. fig. 12), the extreme condition of some specimens of *Papio* is approached, the lacrymal

encircling completely the fossa and protruding on the face above and below the former. The whole of the fossa is likewise encircled by the lacrymal in a specimen of "*M. sinicus*" (Br. M. No. 1102 *b*), but here both maxilla and lacrymal participate in the formation of the *crista anterior*.

In the remnant of the skulls of *Macacus* (63) (Pl. XII. fig. 10) the conditions are those described by Gegenbaur ("*Inuus*"). The same is the case in the few specimens of *Inuus ecaudatus* at my disposal.

Cercopithecus.

Ninty-five specimens examined.—Here too, as in *Macacus*, we meet with the two extremes. In 12 skulls—*C. cephus* (4), *C. nictitans*, *C. melanogenys*, *C. sp.* (Br. M. No. 67.4.12.15), *C. erxlebeni*, *C. sabæus*, *C. cynosurus*, *C. mona*, *C. schmidt*,—young and old, the *crista anterior* is entirely supported by the maxilla, which generally descends into the fossa. In seven skulls the opposite takes place, the fossa being entirely encircled by the lacrymal; and as the *crista anterior* is generally flattened, the fossa cannot be said to be inside the orbit—" *C. sabæus*" (Br. M. No. 20 *h*), *C. cephus* (No. 783 *e*), *C. samango* (Br. M. No. 14 *a*), *C. campbelli* (Br. M. No. 1078 *a*), *C. albogularis* (Br. M. No. 0.2.1.4, No. 92.10.18.8, and No. 92.10.18.9) (Pl. XI. fig. 5). In five skulls—viz.: *C. schmidt* (Br. M. No. 98.10.10.1), "*C. cephus*" (Br. M. No. 783 *a*), *C. albogularis* (Br. M. No. 17 *c*, No. 92.10.18.7, and No. 17 *a*)—the *crista anterior* is almost exclusively supported by the lacrymal. It will be observed that the extreme development of the lacrymal chiefly occurs in the "*Melanochiri*" group of the genus.

Cercocebus.

Five skulls.—In the few specimens of which I have examined the condition of the lacrymal—two of *C. æthiops*, one of *C. albigena*, two of *C. fuliginosus*—the fossa is completely or almost completely encircled in front by the lacrymal.

Miopithecus.

Only four skulls have been examined, a young specimen with the deciduous teeth in place, and three adult, one of which has the teeth much worn. In all of them the *crista anterior* is entirely supported by the maxillary, which encroaches also on the fossa, behind (Pl. XII. fig. 9).

Nesopithecus.

For the sake of comparison with both Lemurs and Monkeys, I have reserved for the end the Malagasy subfossil *Nesopithecus*. As shown by the figures (Pl. XI.), the two species, *N. australis* and *N. roberti*, present differences in their lacrymal region, dependent on the facial cranium being somewhat more produced in the former than in the latter, in which the profile is steeper.

In *N. australis* (Pl. XI. fig. 1) we have the *crista posterior lacr.*—less flattened than the *crista ant.*—dividing the lacrymal into an intra-orbital and a slightly extra-orbital portion. The whole anterior margin of the fossa l. is formed by the maxilla, to a larger extent than is the case in *Propithecus* (Pl. XI. fig. 4). As the comparison of the figures will show, the lacrymal and its fossa are less produced on the face than in the extreme cases of platyrrhine and catarrhine monkeys.

In *Nesopithecus roberti* (Pl. XI. fig. 2) the *crista anterior* is stronger than the *crista posterior*, of which the antero-inferior portion is much flattened. The fossa and the whole of the lacrymal bone remain within the orbit. The lower part of the *crista anterior*, which forms the anterior boundary of the fossa, is supported by the maxilla. In the upper part the lacrymo-maxillary suture runs on the *crista anterior*, both bones consequently partaking in its formation. This is precisely the condition presented by some platyrrhine monkeys (e.g. *Brachyurus* and some species of *Nyctipithecus*) and by the majority of the lower Catarrhinae.

SUMMARY AND CONCLUSIONS.

It has been said that in the lower Mammalia the lacrymal belongs to the bones of the face ("Antlitzknochen"), and that in the Sauropsida it is likewise situated mostly on the surface of the cranium¹. I am not so sure that what we call lacrymal in the Sauropsida is exactly the homologue of the Mammalian lacrymal; but apart from that, the great elongation of the facial cranium, where it occurs in the Reptilia, may or may not be the primitive condition. Leaving therefore aside the Sauropsida, and coming to the Mammalia, it is not a character of Insectivora generally² to have their lacrymal for the greater part, and the *canalis lacrymalis* as well, on the surface of the skull. In the Insectivora with a largely produced facial portion, e.g. *Erinaceus* and *Centetes*, the first stages, if W. K. Parker's³ figures are to be relied upon, have the *canalis* inside the orbit.

As to the Prosimiæ, if in the future we come upon forms in the Middle or Lower Tertiaries exhibiting a facial expansion of the lacrymal, and a facial fossa l., it will then be the time to ventilate the question, whether a similar condition might after all be the primitive one in the Prosimiæ. For the present we have to reckon only with the known facts. In *Adapis parisiensis* we have found the fossa lacrymalis as well as the whole bone to be inside the orbit; the lacrymal is fairly large. From this condition, the form of the lacrymal of recent Lemurs generally can have been arrived at by the development of a *crista posterior*; that of the non-Malagasy Lemurs, besides, by a gradual reduction of the lacrymal;

¹ Gegenbaur, *op. cit.* p. 174.

² *Id. ibid.*

³ W. K. Parker, "On the Structure and Development of the Skull in the Mammalia, III. Insectivora," Phil. Trans. R. Soc. 1885, pl. 20. fig. 3, pl. 32. fig. 3.

that of the Malagasy Lemurs, on the contrary, by an increase in size of the *pars facialis*. The large expansion of the lacrymal on the face and the anterior bordering of the canalis by the latter bone, both characters which amongst the Prosimiæ occur only in the Malagasy Lemurs, are rather an exception within this group; they go hand in hand with the elongation of the facial cranium generally. As a rule in the Malagasy Lemurs the *pars facialis* is of moderate size, and the anterior boundary of the fossa is provided by the maxilla. In the Oriental and Ethiopian Lemurs the maxilla *always* borders the fossa to a large extent and chiefly in front; the *pars facialis* is reduced to a minimum; the *pars orbitalis* is also reduced, owing chiefly to the encroachment by the planum. In two genera (*Loris*, *Nycticebus*) the lacrymal disappears entirely from the outer surface of the cranium, outside and inside the orbit.

Amongst the Platyrrhinæ, only in *Mycetes* and *Ateles*, and, up to a certain extent, in *Brachyteles* and *Callithrix*, the fossa l. shows a tendency to expand upon the face; whilst in all the other genera, at the top of which are *Lagothrix*, *Chrysothrix*, and *Cebus*, the lacrymal remains inside the orbit. The *crista anterior* being formed by the maxilla, the same condition as in Anthropoid Apes and Man is arrived at, and, as in them, it coincides with the reduced size of the facial cranium.

In the lower Catarrhinæ the anthropoid condition is verified in *Miopithecus*, *Rhinopithecus* (Pl. XI. fig. 8), and *Semnopithecus*, in a minor degree in *Colobus*. In all the other genera of Cercopithecidæ—*Nasalis*, *Cercopithecus*, *Cercocebus*, *Inuus*, *Macacus*, *Cynopithecus*, *Papio*—the condition of the lacrymal region is, as a rule, further removed from that of Simiïdæ and *Homo* than in the great majority of Platyrrhine genera. In extreme cases, when the facial region is lengthened, in these Cercopithecidæ also the lacrymal expands on the face and the fossa tends towards a pre-orbital position.

Summing up, and in order to arrive at a generalization, the following points are to be insisted upon:—

A great facial expansion of the lacrymal, and particularly its extension beyond the *fossa lacrymalis*,—

1. Does not occur, the converse being the case, in the one Tertiary Lemur of which the lacrymal region is known;
2. It is scarcely more frequent in Lemurs than in the higher groups; the greatest reduction of the lacrymal occurs precisely within the Prosimiæ;
3. It is at its minimum in young individuals;
4. The genera of each group in which this character is presented have certainly no closer relationship with those of another group;
5. It can always be traced back to an elongation of the facial cranium, necessitated by a more powerful dentition.

The conclusion is, that a great facial expansion of the lacrymal, and particularly its extension beyond the *fossa lacrymalis*, is, in

the Lemurs, as well as in the Monkeys, not a primitive condition, but an extreme specialization.

The postorbital region, to which the figures of Plate XIII. refer, has been examined in about 1100 skulls of Monkeys (exclusive of the Anthropoids, except *Hylobates*) and 300 of Lemurs; so that the ten figures are only just sufficient to give a general idea of the gradual changes. For all the particulars the reader is referred to a separate publication. In the characters of this region the Lemurs do not stand apart as has been supposed (Virchow); they represent the most generalized condition, closely related to what obtains in the majority of the platyrrhine Monkeys. From the Lemurs to the higher Monkeys takes place a gradual restriction and throwing back of the parietal, brought about by the greater extension, first of the malar, and subsequently of the frontal, alisphenoid, and squamosal. Phases in this whole process of evolution are the differences between the Platyrrhinæ and Catarrhinæ (discussed by Cuvier, Joseph, Anutschin, W. A. Forbes), and the union of the squamosal with the frontal; the latter being the terminal stage. As regards Man, the fronto-squamosal union is not an atavism; where it occurs it is—apart from pathological cases—a specialization, just as in Monkeys. What has rather the appearance of an atavism is the speno-parietal union when it occurs in the Gorilla and the Chimpanzee.

EXPLANATION OF THE PLATES.

PLATE XI.

Lacrymal region of Lemurs and Monkeys.

l.=lacrymal; *mx.*=maxillary; *ma.*=malar; *pl.*=planum; *er.a.mx.*=crista anterior of the maxillary; *cr.p.l.*=crista posterior (of the lacrymal).

- Fig. 1. *Nesopithecus australis* Maj. (Br. M. Geol. Dep.).
 2. *Nesopithecus roberti* Maj. (Br. M. Geol. Dep.).
 3. *Mycetes palliatus*, young (Br. M. Z. D. No. 96.6.1.1).
 4. *Propithecus edwardsi*, young (Br. M. No. 75.1.29.6).
 5. *Cercopithecus albogularis* ♂ (Br. M. No. 92.10.18.9).
 6. *Mycetes palliatus* (Br. M. Salvin's Coll.).
 7. *Chrysotrrix sciureus* (Br. M. No. 45.8.5.8).
 8. *Rhinopithecus roxellanae* ♀ (Br. M. No. 99.3.1.2).
 9. *Papio anubis* (Br. M. No. 45.6.17.14).
 10. *Papio* sp. inc. (Br. M. No. 0.1.3.2).

PLATE XII.

Lacrymal region of Monkeys.

- Fig. 1. *Brachyteles arachnoides* (Br. M. No. 43.10.12.2).
 2. *Midas geoffroyi* ♀ (Br. M. No. 0.5.1.63).
 3. *Colobus caudatus* ♂ (Br. M. No. 0.2.1.1).
 4. *Ateles fusciceps* (Br. M. No. 1514 a).
 5. *Midas rufiventer* (Br. M. No. 54 a).
 6. *Ateles vellerosus* ♀ (Br. M. No. 89.12.7.2).
 7. *Callithrix personata* (Br. M. No. 45.4.2.11).
 8. *Sennopithecus natunæ*, ♂ type (Br. M. No. 94.9.28.1).
 9. *Miopithecus talapoin* ♂ (Br. M. No. 0.2.5.8).
 10. *Macacus rhesus* (Br. M. No. 58.6.24.144).
 11. *Nasalis nasicus* (Br. M. No. 13 e).
 12. *Macacus nemestrinus* (Br. M. No. 28 c).